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THESIS

LISTENING VERSUS READING
OF TRUE-FALSE TEST
IN BOOKKEEPING

Submitted by

LORETTA JULIA BURKE

(B. S. Simmons College, 1922)

In partial fulfillment of the requirements
for the degree

of
Master of Education
1934

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INTRODUCTION

One of the modern developments in the educational world is known as the Testing Movement. Up to the year 1900 practically the only forms of examination used were the conventional essay type and the quiz. With the development of science and experimental psychology came also the study and measurement of individual differences.

Measurement is essential in the education process. Since learning takes place more readily when the results are accompanied by satisfaction, activity is essential in learning. One must, therefore, be able to measure success or failure and improvement. Measurement in education aims to do this.

Although it is difficult to define the exact lines of demarcation, Monroe¹ states there are four distinct types of procedures employed in measuring school achievements:

1. Monroe, Walter S. Directing Learning in the High School New York: Doubleday Doran & Company, Inc. 1927, p.492

INTRODUCTION

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1. Norris, Walter B. Measuring Learning in the High School New York: Technology
Norris & Company, Inc. 1927, p. 422

(1) informal estimating of performances, both oral and written; (2) written examinations of the essay type; (3) written examinations consisting of exercises constructed so that the marking of the papers is highly objective, frequently called "new examinations"; (4) standardized tests which are distinguished from "new examinations" by the norms or standards which have been determined for the interpretation of the measures obtained.

The essential characteristic of the "new examination" is that the exercises are constructed so that only one response is correct and hence the scoring is objective rather than subjective. "New examinations"² are limited to those responses that may be classified as either right or wrong. They may be used to measure specific habits, including memorized facts, but it does not appear that they can be used to measure knowledge, ideals, or attitudes directly. Questions which ask the student to

2. Ibid, p. 497

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define, explain, discuss, give reasons why, compare are excluded.

It is extremely interesting to note that as early as 1845, Horace Mann laid down eight advantages³ of the objective test over the conventional form of essay test, which are as follows:

1. It is impartial.
2. It is just to the pupil.
3. It is more thorough than the older forms of examination.
4. It prevents the "officious" interference of the teacher.
5. It determines beyond appeal or gainsay whether or not the subject-matter has been faithfully and competently taught.
6. It takes away all possibility of favoritism.
7. It makes the information obtained available to all.
8. It enables all to appraise the ease or difficulty of the questions.

However, the objective examination has a serious disadvantage over the essay

3. Ruch, G. M. The Improvement of the Written Examination, New York: Scott, Foresman & Co. 1924, p. 7

define, explain, discuss, give reasons why,
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7. It makes the information
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8. It enables all to appreciate the
ease or difficulty of the
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However, the objective examina-

tion has a serious disadvantage over the essay

type examination in that it does not furnish the opportunity for self-expression in written language.⁴

While the value of the written essay form of examination does furnish greater opportunity in the use of English composition, it is somewhat debatable as to just how valuable this sort of exercise is when we consider first that most examinations as given are not and should not be given as a test particularly in English composition, but rather as a test in knowledge of the subject-matter covered during a given period; and second, the very hurried and brief way pupils are expected to record their answers, frequently in outline form, when neither teacher nor pupil has much if any concern regarding the English used but for getting the largest number of questions answered within the limited length of time at their disposal.⁵

The essay type, though highly subjective, should not be abandoned altogether

4. Odell, C. W. Traditional Examinations and New-Type Tests Century Co. 1928, p. 14

5. Ruch, C. M. op. cit. p. 7

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4. Odell, G. W. Traditional Examinations and New-
Type Tests Century Co., 1922, p. 14
5. Luch, G. W. op. cit. p. 7

but rather its use might be richly supplemented by a much more extensive use of the objective tests.⁶

In the commercial field, it is possible to reproduce approximately in tests the same situations and to call for the exercise of the same abilities encountered in actual practice. The desirability of measuring such intangible outcomes as appreciations, ideals, and so forth, does not arise.⁷

The most commonly used types of objective tests are the true-false, completion, multiple-choice, and matching tests.⁸

The best type of objective test for quick review is the true-false, by which a great deal of ground can be covered in a very short time.⁹

It is with the true-false type of objective test that this thesis deals.

6. Odell, C. W. op. cit. p. 14

7. Odell, C. W. op. cit. p. 336

8. Tiegs, E. W. Tests and Measurements for Teachers
Houghton Mifflin & Co. New York p.243

9. Ruch, G. M. and Stoddard, G. D. Tests and Measurements in High School Instruction, World Book Co. 1927, p. 268

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6. Odell, C. W. op. cit. p. 14
 7. Odell, C. W. op. cit. p. 236
 8. Tiers, R. W. Tests and Measurements for Teachers
Houghton Mifflin Co., New York 1924
 9. Rich, O. E. and Stachard, G. D. Tests and Measure-
ments in High School Instruction, World
Book Co., 1927, p. 238

Now true-false tests have certain advantages and certain disadvantages over other types of objective tests which may be listed as follows:¹⁰

Advantages:

1. Increased reliability
2. Greater objectivity
3. Time taken to give the test relatively short
4. Time required to score it also short
5. Ground covered more extensive
6. Saving of pupil's effort.

Disadvantages:

1. Do not measure the most important outcomes of learning, such as a pupil's attitude toward the subject matter, or his originality.
2. Their preparation is too time consuming.
3. They provide no training in organization and expression.
4. Some of the tests appeal too much to memory.
5. They permit guessing.

10. Hyde, R. E. Guessing and Success on the True-False Test Educational Methods Vol. 8:230-1 January 1929

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All articles regarding true-false tests mentioned in the Educational Index from January 1929 to April 1934 were read and are summarized as follows:

Dwight in his study¹¹ presents the psychological question in regard to the undesirability of placing misleading statements before pupils. He says: "When true and also false statements are spread out before the students, is it not possible that the latter will happen to arrest attention and fix impressions, in such a way that, after the classroom doors have been locked and all have gone home, it will be the erroneous statement that will continue to stare at the pupils (some of them, at least) or be read as from a blackboard in their brains?"

Dwight states that the majority, perhaps two-thirds of the pupils are predominantly visualizers. An impression through the eye on the mind may be rapid and the reaction may persist as a mental twist. At best, the whole

11. Dwight, C. A. A. What is False About True and False Educational Method
Vol. 10:557-8 Je '31

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effect of a true-false statement is that of a blur, a confusion, a mystification, "from which the escape mayhap is by means of a guess."¹²

He claims that positive injury is done to the pupil inasmuch as a false statement has at least as good a chance to live on in the memory as has a true one. Even where the student has answered a negative to a false statement and that too not as a mere guess, the effect of its visualization may in subtle and confusing ways or degrees remain.

Dwight further states that, if his argument be correct, the difficulty cannot be wholly removed by a propounding of the statements orally, since about one-third of pupils are audiles.

Jersild¹³ is of the same opinion as Dwight in regard to this aspect of the true-false test. He states in his article: "It appears that the true-false test is of dubious value as a pedagogical instrument (only insofar as the

12. Ibid

13. Jersild, A. T. Examination as an Aid to Learning
Journal of Educational Psychology
 Vol. 20:602-9 Nov. 1929

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test should serve as an aid to learning.)" He goes on to say that on purely theoretical grounds it is open to two serious charges. First, a test of this kind, presenting as it does a random and unpredictable intermingling of true and false propositions, may have just as much the effect of perpetuating error as of strengthening proper associations and stimulating wholesome curiosity. Each statement calls for a categorical true or false. Whether the response is right or wrong, the mere act of putting a stamp of affirmative or denial on a given statement has the effect of strengthening the association so formed.

Another shortcoming he attributes to the true-false test is the fact that it does not make strong demands upon the industry of the examinee. He states that "It is more nearly a test of passive recognition than of active recall." "In responding to a true-false test", he continues, "the student is not called upon to organize his knowledge or to reduce it to systematic statement with proper emphasis in

fast should serve as an aid to learning." He goes on to say that on purely theoretical grounds it is open to two serious charges. First, a test of this kind, presenting as it does a random and unpredictable intermingling of true and false propositions, may have just as much the effect of counterbalancing error as of strengthening proper associations and eliminating wrong ones. Secondly, such a statement calls for a categorical answer, true or false. Whether the response is right or wrong, the mere act of making a statement of affirmative or denial on a given statement has the effect of strengthening the association so formed.

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the most significant details."

He concludes that a direct interrogation constitutes a more intense stimulus than does a narrative statement and will, accordingly, give rise to a more lively response, and that an examination serves as an aid to learning insofar as it puts this principle to a practical account by stimulating the industry of the learner.

Contrary to the above opinions are those of Arnold¹⁴ who states that the experience resultant from the taking of true-false tests should aid in developing the habit of asking in regard to every statement, "Is this true?". The fact that this type of test creates doubt is not a fault, he claims, but a merit, because one of the dangers besetting our form of government is "the effectiveness of fallacious and insidious propaganda."¹⁵ A method which would result in a decreased tendency to believe whatever is in printed form, is from that standpoint to be commended. Thus it would seem that the "true-false" idea in testing has an intrinsic

14. Arnold, H. L. Defense of the True-False Test
California Quarterly Secondary
Education 4:145-6 Ja. '29

15. Ibid

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14. Arnold, W. I. Defense of the True-False Test
 California Quarterly, December
 1929, Vol. 3, No. 4, p. 145-8.

value in training for citizenship. The setting in this type of test is that of a life situation. Everyone is required constantly to face questions involving a decision of "true" or "false".

While pupils sometimes guess in giving responses to this type examination, it should not be forgotten that pupils sometimes guess when taking other types of tests.¹⁶

As each pupil makes a decision on successive items in a true-false test, his responses might be separated into three rather distinct categories:¹⁷

First, he may be said to have exact knowledge of an item when he is absolutely sure of the answer:

Second, he may be said to have part knowledge of an item when he knows something about it but is not positive of the answer;

Third, there are a number of items of which the student is certain that he has no knowledge and any answer here made would

16. Odell, C. W. op. cit. p. 15

17. Melbo, I. R. How much do Students Guess in Taking True-False Examinations
Ed. Methods 12:485-7 My '33

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Third, there are a number of items of which the student is certain that he has no knowledge and any answer he would

probably be a pure guess.

The typical "do not guess" instructions define guessing as "any response made without a better basis than pure chance."

Melbo in his study defines "guessing" to mean "any situation wherein the student taking the test is definitely sure he knows nothing at all about the true-false item under consideration, and that any answer he may give is just a 'pure guess' with an equal (fifty-fifty) chance of being either right or wrong."

On this basis, a uniform direction sheet for use in connection with all true-false tests was prepared. A true-false test of fifty items was given to a class of twenty-three college students taking a course in elementary sociology. When this class claimed exact knowledge, their responses were correct 68% of the time. When guessing was indicated, their responses were only 59% correct. These preliminary results verified the theoretical assumptions with the exception that the use of the new directions for indicating states of knowledge may have

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affected the reliability of the tests. To clear this point, two different tests with equivalent forms were devised. The new directions were used with only one form. The tests were given to students in each of the various levels in both the high school and college departments of New Mexico State Teachers College. A total of 67,770 responses from 1,480 different test papers were tabulated.

The findings were as follows:

1. Students guess 14,53% of the time, use part knowledge almost 46% of the time, and use exact knowledge on nearly 50% of the true-false items;

2. When students claim to know the answer exactly, they are actually right about 87% of the time, for part knowledge 72% right, and for pure guessing the chances are as 585 to 415 that the answer will be right;

3. Students get about 77% of their total true-false items right and about 23% wrong; of the total number of rights, 56% come from items of which the students have exact

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The findings were as follows:

1. Students guess 56,541 of the time, use past knowledge about 451 of the time, and use exact knowledge on nearly 301 of the true-false items;
2. When students claim to know the answer exactly, they are actually right about 374 of the time, for past knowledge 731 right, and for pure guessing the chance was as 505 to 415 that the answer will be right;
3. Students get about 774 of their total true-false items right and about 224 wrong; of the total number of rights, 505 come from items of which the students have exact

knowledge, and only 11% from pure guess; of the total number of wrongs, 29% come from exact knowledge, 44% from part knowledge and 26% from pure guess.

The coefficient of correlation between the tests containing the new directions and those containing the usual directions was .93

Krueger¹⁸ conducted his study to determine experimentally (1) the distributions of frequencies based on the number of correct guesses in "true-false tests" of various lengths, and (2) to find a practical length which would eliminate the probability of getting a high score by chance guessing.

He found a definite and obvious trend indicating that the longer the test is, the greater is the frequency of scores within the class intervals ranging from 41% to 60% of the number of items in the test. For the longer tests, practically all scores ranged within 45% and 55% of the total test. He also found that chance guessing may frequently yield very high

18. Krueger, W. C. F. Distribution of Scores Based on Correct Guessing for True-False Tests of Various Lengths J. Ed. Psy. 24:185-8 Mr.'33

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Kreuger¹⁹ also planned an experiment to suggest answers to the following problems:

1. Will a person write "true" more often than "false" when he guesses his answers at random in a true-false test? What proportion of these guesses are incidentally guessed correctly?

2. When a person is limited to fifty per cent of the guesses as "true" and fifty per cent of the guesses as "false" what proportion of the guesses will happen to be correct?

A list of 100 words, 100 syllables, and 100 numbers were presented to some one hundred three students. The group was informed that later the instructor would read to them a series of words, syllables and numbers selected from the tests before them. They were to select or guess which of the items the experimenter had selected.

19. Krueger, W. F. Experimental Study of Certain Phases of a True-False Test Journal Educational Psychology 23:81-91 F'32

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¹⁰ Krueger, W. F. Experimental Study of Certain Types of a True-False Test. Journal of Educational Psychology 22:51-52 1932

It was found that the average number of items guessed as "true" was as follows:

Words	51.10%
Syllables	50.90%
Numbers	51.00%

Number of items guessed correctly:

Words	49.87%
Syllables	50.02%
Numbers	49.75%

It is noted that "true" was written after slightly more than fifty per cent of the items. The frequency of correctly guessed items, when checked by a key of fifty true and fifty false items, averaged almost fifty for the three lists.

In the next step to the experiment, the subjects were directed to limit their guesses of "true" to fifty and their guesses of "false" to fifty. The same lists as used in the first experiment were given and the subjects still were forced to guess since they had no information upon which to base their decisions. The average frequency of correctly guessed items was 50.27%, 50.03%, and 50.23% respectively for the three types of material. Incidentally, if the right

It was found that the average number of items guessed as "true" was as follows:

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Syllables	50.30%
Numbers	51.00%

Number of items guessed correctly:

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Syllables	50.08%
Numbers	49.75%

It is noted that "true" was written

after slightly more than fifty per cent of the items. The frequency of correctly guessed items, when checked by a key of fifty true and fifty false items, averaged almost fifty for the three lists.

In the next step to the experiment, the subjects were directed to list their guesses of "true" to fifty and their guesses of "false" to fifty. The same lists as used in the first experiment were given and the subjects still were forced to guess since they had no information upon which to base their decisions. The average frequency of correctly guessed items was 50.75%, 50.05%, and 50.35% respectively for the three types of material. Incidentally, if the right

minus wrong formula had been used the average scores would be approximately zero.

In connection with this phase of guessing in true-false tests, it is interesting to note the experiment of Brinkmeier and Keys²⁰ inspired by their convictions that the amount of guessing which takes place in the average true-false examination is much greater than is commonly realized even by those who are being examined, and that many of the statements in such examinations can be recognized as true from their form and nature, apart from any knowledge of the particular subject matter involved.

It is agreed that certain words or phrases in true-false statements often serve as "specific determiners" giving fairly dependable cues to the correct response.

An overwhelming proportion of statements containing the words "all", "always", "only", "no", "never", and "none" will be false, while statements qualified by "most", "some", "probably", "may", "often", and the like are true.

20. Brinkmeier, I. H. and Keys, N. Circumstantiality as a Factor in Guessing on True-False Examinations. Journal Educational Psychology 21:681-94 D. '30

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W. Winkler, I. Kevs, "A Determination of the Effect of Guessing on True-False Examinations," Journal of Educational Psychology, 1934, 25, 130.

Pupils soon become aware of these peculiarities of true-false tests and there is little doubt that much of the practice effect which gives so distinct an advantage to the "test-wise" pupil must be attributed to increasing sensitivity to cues of this sort.

The experimenters had access to 376 objective examinations submitted in a nation-wide prize contest. These examinations, assembled from thirty-one states, covered all the principal departments of high school instruction, although slightly more than half dealt with English and the Social Studies. They included a total of 10,756 true-false statements. Inspection of these last convinced the writer that more than one-fifth of the statements were of such a nature that their truth or falsity might be correctly inferred by an intelligent and "test-wise" reader, regardless of his knowledge of the subjects. After eliminating the false statements in this list and all true items containing one or more cue words and phrases of the specific-determiner variety, there remained one hundred

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statements the truth of which might be regarded as to some extent self-evident. From this number a random sampling of fifty was drawn. The quality which these questions had is perhaps best described as a "certain circumstantiality of content and phrasing."²¹

The following statements which were taken from the list will serve to illustrate this quality:

"Democracies need thinkers who will cooperate in the solution of problems."

"Johnson was a great scholar and the most important member of the famous Literary Club."

There is also a strong presumption on the part of students to the effect that long statements in a true-false examination will be true ones; e.g. "In Virginia, the growing of tobacco led to the occupation of large tracts of land and made impossible the establishment of the town with its local democratic features of meeting house and public school."

Furthermore, when length takes the form of a cataloging of details, this presumption becomes a certainty; e.g. "The first

²¹. Ibid

statements the truth of which might be regarded as to some extent self-evident. From this number a random sampling of fifty was drawn. The quality which these questions had in common was described as a "certain objectivity of content and phrasing."²¹

The following statements which were taken from the list will serve to illustrate this quality:

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Furthermore, when length takes the form of a cataloging of details, this presumption becomes a certainty; e.g. "The first

quarter of the nineteenth century saw the beginnings of a true literature in the department of poetry, fiction, and belles-lettres."

In addition to the fifty statements, a second list of twenty-five statements of the experimenters' own construction was prepared. These were modeled closely upon statements in the first list, and all shared the common characteristic that they would assuredly be branded as false by one fully cognizant of the facts.

The fifty true-statements and the twenty-five false statements were thrown together. To offset in part the number of obviously true statements, the experimenters next selected from the examinations submitted twenty-five additional items regarded as obviously false. Typical of these last were such statements as "Daniel Boone was one of our presidents." "Hatcheries are built to destroy fish." The entire 100 were then intermingled in chance order and mimeographed under the title of a "General Information Test".

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classes of high school pupils and to a group of one hundred senior and graduate students at the University of California. Each statement was to be marked true or false on its own merits. In case the student did not know the answer to a given statement he was instructed to guess, but any answer in which guessing was necessary was to be indicated by a question mark placed after the plus or minus sign. Students were also assured that their answers would in no way affect their class marks. Twenty-five minutes were allowed for marking the statements, which proved ample for practically all members.

Responses to each of the one hundred test items were then tallied separately according to whether the statement was marked true or false, and whether guessing had been indicated by a question mark.

Each of the fifty obviously true statements received a clear majority of "Trues" ranging from 98.9% to 56.1%

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classes of high school pupils and to a group of one hundred senior and graduate students at the University of California. Each statement was to be marked true or false on its own merits. In case the student did not know the answer to a given statement he was instructed to guess, but any answer in which guessing was necessary was to be indicated by a question mark placed after the plus or minus sign. Students were also assured that their answers would in no way affect their class marks. Twenty-five minutes were allowed for marking the statements, which proved ample for practically all members.

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The study showed that students who believed that they knew the answer to these

statements were right only 81% of the time, while those who admitted they were guessing were correct in 70%. Such figures go far to substantiate the impression that statements of the type of the fifty obviously true statements bear too many surface indications of the reply expected, and are poorly adapted to distinguish between the well-informed and the merely shrewd pupil.

In the total replies to the false statements, however, the "Trues" outnumbered the "Falses" by approximately 3 to 2.

While superior knowledge enabled the university students to outdo the high school pupils in the number of statements recognized as false, the general effect of circumstantiality of form in suggesting the response of "true" was evidently much the same for both groups. It also follows that, in addition to being careful in the use of cue words or phrases which act as "specific determiners" of pupils' responses, it would seem best to eliminate as far as possible the types of true statements which bear so many surface indications of their verity as to

statements were right only 61% of the time, while those who admitted they were guessing were correct in 70%. Such figures go far to substantiate the impression that statements of the type of the fifty obviously true statements bear too many surface indications of the reply expected, and are poorly adapted to distinguish between the well-informed and the merely shrewd pupil.

In the total replies to the false statements, however, the "true" outnumbered the "false" by approximately 5 to 3.

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be of little value for purposes of measurement.

To determine the exact relationship which it was felt existed between the word-length of statements and their truth or falsity, data were derived by Brinkmeier²² from true-false statements included in the 376 examinations previously mentioned as entered by teachers in the national-wide contest in the construction of objective examinations conducted by Drs. G. M. Ruch and G. A. Rice. Again 6,671 statements were made available for this study.

Each statement was recorded as true or false as the case happened to be, likewise the number of words contained in those statements were tabulated. A frequency distribution table was constructed showing the grouping of the word-lengths of statements in step-intervals of five, the frequency of true and false statements in each group, the percentage of true and false statements and the probable error of these percentages.

Of the 6,671 statements analyzed

22. Brinkmeier, I. H. Sentence-length as a Specific Determiner in True-False Statements. J. Ed. Res. 22:203-5 0'30

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Of the 6,871 statements analyzed

²² E. Brainerd, I. H. Sentence-length as a Specific Determinant in True-False Statements, J. Ed. Res., 22: 203-207, 1930

51.8% were true statements, and 32.4% were false.

Of these statements, 65.8% were composed of from 6 to 15 words. In other words, about two-thirds of all the statements were composed of fifteen or less words.

Of 4,773 statements containing from 3 to 15 words, 48.3% were true and 51.7% false. That is all statements composed of 15 words or less tend to be false as often as true.

Long statements, that is, those composed of from 20 to 25 words were found to be true in almost 66% of the cases, while those composed of more than 25 words tend to be true in about 80% of the cases.

A probable explanation of the tendency for long statements to be true is that teachers in attempting to construct true-false statements that may be defended as definitely either true or false, add dependent phrases or clauses. The evidence indicates that those dependent phrases and clauses tend to erase any possible falsity of the statements.

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It is frequently said it is

better to record the first answer that comes to

the mind in taking a true-false test than to stop to meditate or reason on the question. This idea is based on the fact that true-false tests are in large measure recognition tests, and that the first response to an idea is sometimes more reliable than the response that occurs after mature reflection.

In an experiment performed by Lowe and Crawford²³ two types of procedure were used.

One was the actual tabulation of specific changes of answers in true-false test papers answered under ordinary circumstances without any thought of such an investigation on the part of the students involved. This procedure assumed that any answer that was not changed was a "first impression" answer, and that any answer that was changed was a "second thought" answer. This is not necessarily a safe assumption since many unchanged answers are "second thought" answers which were not written down in both forms.

23. Crawford, C.C. and Lowe, M. L. First Impression Versus second Thought in True-False Tests. Journal Educational Psychology 20:192-5 Mr. '29

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The second type of procedure used was designed to correct this weakness. A large class was divided into Groups A and B. A true-false test was prepared in two parts, I and II. Each test was mimeographed so that two spaces were allowed for answering each question. The first space was for "first impression" and the second was for "second thought." Group A was asked to take Test I by answering rapidly all questions in the "first impression" space and then to return and answer each with more mature reflection in the "second thought" space reversing the previous decision wherever desired.

At the same time, Group B was asked to take Test I by a "delayed answer" form of second thought. This consisted of reading all questions over without answering any of them and then returning to answer each in the "second thought" space on the sheet. This was to prevent the record of the first impression from influencing the final second thought decision. After Test I was finished in this manner each group took Test II, but the methods were reversed.

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Data secured showed a definite superiority of changes from wrong to right over changes from right to wrong, with the ratio being almost exactly two to one for the total number of changes.

No significant advantage is shown in having each student read the questions over before answering them, since the "delayed answer" scores were almost exactly equal to the "first impression" scores.

A very important factor in this experiment is the amount of changing of answers which took place when the students were asked to record their "second thought" decisions. There were two hundred forty-seven changes out of a total of 2,416 answers or almost exactly ten per cent. In other words, "first impression" decisions were still clung to in nine out of ten cases on more mature consideration.

To neutralize the effect of guessing, the right minus wrong formula has been approved by a number of writers, who have varyingly recommended that the examinee either

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To emphasize the effect of guessing, the right minus wrong formula has been approved by a number of writers, who have variously recommended that the examinee either

be or not be encouraged to guess the correct answer. Barton²⁴ states in his study that he has always been skeptical about the validity of the right minus wrong formula because it seemed to assume that every item wrongly judged was very likely to be a result of guessing. He also disapproved of the formula because many students have the feeling that their scores do not truly represent their actual achievement on a test.

The following directions were subsequently used in giving twenty-five true-false tests to students:

"If you think a statement is true, write a plus sign in the blank printed before it.

If you think a statement is false, write a minus sign in the proper blank, and then draw a line through the word or the words that make the statement false.

Omitted items will not be given any credit.

A blank containing both a plus and a minus sign will be scored as wrong.

To get credit for judging a false item, you must draw a line through the word or the words that make it false.

24. Barton, Jr., W. A. Improving the True-False Examination School and Society
34:544-6 O 17 '31

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²⁴ Barton, Jr., W. A. Improving the True-False Examination. School and Society, 1911, 22, 121-122.

Your score will be the number of items you judge correctly."²⁵

The above directions provide a cross-out method for indicating the reason for judging an item to be false.

For each of these tests the reliability was computed, both when the right minus wrong formula was used and also when credit was allowed for each correctly judged item. The data showed an actual difference of .11 in favor of the coefficient of correlation when the student was allowed credit for every item judged correctly. Examination of the table showed that in only four out of the twenty-five cases was the correlation greater when the right minus wrong method of scoring was used.

It was concluded by Barton that the cross-out method has the following advantages:

1. It probably reduces guessing to a minimum in judging true-false items;
2. It has specific diagnostic value in determining the student's comprehension of the test items;

25. Ibid

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2. It has specific diagnostic value in determining the student's comprehension of the test items;

3. It makes true-false tests a task of reasoning as well as of recall; moreover time consumed in taking tests by this method is uniformly greater because of the seriousness with which the students judge the items;

4. Reliability of short tests is greatly increased by this method;

5. When this method is used it is unnecessary for the test constructor to make the true-false items equal in number. For this reason artificiality of wording can be greatly reduced and the student will have no reason to check over his test to see whether he has judged as many items false as true.

It would appear likely that this training in discovering the real basis of falsity in statements should develop many critical readers unusually adept in perceiving the real meaning of whatever they read.

Paterson and Langlie²⁶ gave a 100-item true-false test on the psychology of advertising to one hundred eleven students. They found a reliability of .63 when the papers were

26. Paterson D. G. and Langlie, T. A. Empirical Data on the Scoring of True-False Tests
Journal Applied Psychology 9:339, 1925

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²⁸ Peterson, E. C. and Langille, T. A. Experimental Data on the Accuracy of True-False Tests. *Journal of Applied Psychology*, 1935, 20, 222-225.

marked right minus wrong.

They state that "Hence, the assumption that the right minus wrong method is more reliable than the number right method of scoring true-false tests is seriously questioned by these facts."²⁷

Wood²⁸ studied true-false tests in several college subjects. The directions given in all cases were "do not guess". He says on Page 8, "In no case does the number right score suffer by comparison with the right minus wrong score, and in only one case does the right minus wrong compare at all favorably with the number right as to reliability."²⁹

The discovery of a method of marking true-false tests by which it was believed one could consistently get right more than half of the questions one did not know, led to a study by Dunlop and others.³⁰

27. Ibid

28. Wood, Ben B. Measurement in Higher Education
New York: World Book Company, 1923

29. Ibid

30. Dunlop, J. W., De Mello, Adrian, And Cureton, Edward E., Effects of different Directions and Scoring Methods on the Reliability of True-False Tests
School and Society 30:378-82 S 14(29

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The method consisted essentially in marking the known items, counting the number of items marked true and the number marked false and marking all the rest in the same manner as the lesser number counted, on the assumption that a properly constructed true-false test contains an equal number of true and false statements.

Two 24-item forms of a yes-no test designed to measure reading comprehension were combined into a single 48-item list. These tests had been carefully standardized. The members of each pair of items were of equal difficulty. Each list was arranged in order of difficulty and consisted of an equal number of true and false items, the average difficulty of the true ones being equal to the average difficulty of the false ones. The combined list was constructed by taking items alternately from each of these lists.

The test was administered to 79 second-year students of the Territorial Normal School, Honolulu. The students were separated into

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three groups. The test was given to each group three times in immediate succession, each time with a different set of directions. Groups were numbered I, II, and III and trials identified as A, B, and C.

Group I was given the trials in the order of A, B, and C; Group II--B, C, and A; Group III--C, A, B.

Although a time limit was used, this was made so liberal that not a single student failed to finish any of the trials.

The directions which differed in each of the trials were as follows:

"Trial A: In this trial, answer each question you absolutely know. Do not guess. Leave all the rest blank."

"Trial B: In this trial, answer every question as you come to it. Do not leave any out. If you do not know the answer to a question, guess. Answer each question before starting the next."

"Trial C: In this trial, answer each question you absolutely know. Then count your Yes's and No's. If you have fewer Yes's than No's, mark all the rest of the questions Yes. If you have fewer No's than Yes's mark all the rest of the questions No. Since the test has an equal number of true and false statements, you will then make a higher score than you would be likely to make by guessing. If you have an

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"Trial C: In this trial, answer each question you absolutely know. Then count your Yes's and No's. If you have fewer Yes's than No's, mark all the rest of the questions Yes. If you have fewer No's than Yes's mark all the rest of the questions No. Since the test has an equal number of true and false statements, you will then make a higher score than you would be likely to make by guessing. If you have an

equal number of Yes's and No's mark all the rest Yes." ³¹

Trial A was scored by both the number right and the right minus wrong formula methods; the other trials were scored by the former method only, the odd and even questions being scored separately.

Trial A showed a significantly higher reliability than Trial B. (Do not guess method with guess method.)

Trial A showed a somewhat higher reliability than Trial C but the difference was not statistically significant. (Do not guess method with fill-in method.)

Trial C was significantly more reliable than Trial B. (Fill-in method with guess method.)

This study concluded that the directions to guess lowers the reliability; the directions not to guess gives a spuriously high reliability. Under any set of directions which cause all students to mark all questions, the number right method of marking may be used instead

31. Ibid

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Trial C was significantly more
reliable than Trial B. (Fill-in method with
guess method.)

This study concluded that the
direction to guess lowers the reliability; the
direction not to guess gives a spuriously high
reliability. Under any set of directions which
cause all students to mark all questions, the
number right method of marking may be used instead

of the right minus wrong method, with a consequent gain in speed and accuracy of scoring.

The authors of this experiment believed they were warranted in concluding that the new directions, under classroom conditions, would probably result in a higher reliability than other directions, and have the added advantage that they might be scored by the number right method.

It is extremely interesting to note that Whidden and Davies of Yale University³² hold that "Whatever method of scoring a true-false examination may be used, the method of scoring by the total of right answers is not satisfactory." If the number of questions is at all large, they believe that a man would be apt to get half his answers correct by sheer guessing. The method of scoring adopted at the Yale Law School for its true-false examinations is this:

Preliminary warning is given that guessing will be penalized, that if an answer has to be guessed, it had better be omitted entirely.

32. Whidden, Jr., C. H. and Davies, F. J. Method for Judging the Discrimination of Individual Questions on True-False Examinations Journal Educational Psychology 22:290-306 Ap.'31

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Preliminary warning is given that

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to be guessed, it had better be omitted entirely.

The examination is scored by adding the sum of omitted answers to twice the sum of wrong answers. The lowest score is the best and the highest is worst. The theory underlying the method is that guessing will be greatly minimized if not entirely eliminated and that simple lack of information on a given question is not to be scored against so heavily as definitely wrong information on that question.

It is felt that the minimizing of guessing through the preliminary warning seems to be accomplished. Out of seven examinations given in June, 1938, it was found on all but one that the group of men with the highest average law grades for the year had a smaller proportion of their examination scores accounted for by omitted answers than did the group of men with the lowest average law grades for the year.

It is agreed that the criteria of a good test in any subject are its validity and its reliability. No teacher is satisfied with an achievement test which does not cover all of the important items which she had taught. No pupil

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It is agreed that the criteria of a good test in any subject are its validity and its reliability. No teacher is satisfied with an achievement test which does not cover all of the important items which she has taught. No pupil

considers a test good which does not stress the important parts of the unit or the course which he has completed. Both of these considerations are matters of the validity of the test. In the language of the test expert the validity of a test refers to the "worthwhileness" of the test.

"Validity is in general the degree to which a test parallels the curriculum and good teaching practice."³³

"A measuring instrument is said to possess validity when it measures what it claims to measure."³⁴

There are two principal methods of validation of tests: (a) curricular and (b) statistical.

A study of the published accounts of the validation of existing achievement tests shows that most of them are of the curricular type. According to Symonds, "In the case of the achievement test, the independent criteria to be used for validation are few in number. One must usually fall

33. Ruch, G. M. The Objective or New-Type Examination Scott, Foreman & Co. 1929, p. 28

34. Odell, C. W. Traditional Examinations and New-Type Tests Century Co. 1928

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There are two principal methods of validation of tests: (a) internal and (b) external.

A study of the published accounts of the validation of existing achievement tests shows that most of them are of the external type. According to Symonds, "In the case of the achievement test, the independent criterion to be used for validation are few in number. One must usually fall

33. Ruch, G. M. The Objective or New-Type Examination.
Scott, Foresman & Co. 1930, p. 28.
34. Odell, G. W. Traditional Examinations and New-Type Tests. Century Co. 1933.

back on school marks or teacher estimates of achievement as a criterion.....Most of the validation (of the achievement test) must be accomplished in the original choice of material of the test."³⁵

"The validation of a test can be no better than the present state of knowledge about the objectives, aims, minimum essentials, social utility, etc. of the curricular content."³⁶

There seems to be a widespread assumption on the part of achievement test constructors and authorities that recall, multiple response and true-false form of items are sufficiently equivalent in validity to justify indiscriminate use from the standpoint of validity. This is indicated indirectly by the manner in which the forms are used in published tests and explicitly by statements in standard books in test construction.

For instance Ruch says: "When validity coefficients are corrected for attenuation, the resulting values are high, showing that

35. Symonds, P. M. Measurement in Secondary Education
The Macmillan Co. 1927 pp.279,280

36. Ruch and Stoddard, Tests and Measurement in High School Instruction World Book Co.
1927, p. 302

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32. Symonds, P. W. Measurement in Secondary Education
The Macmillan Co. 1927 pp. 273-280
33. Bush and Stoddard. Tests and Measurement in High School Education 1925, pp. 28.

true-false, multiple choice and recall tests measure roughly the same abilities"³⁷ and his recommendation concerning the selection of item forms for use in a test include many other considerations but not that of effect on validity.

Odell says: "It is very probable that for particular bodies of subject-matter and for special purposes certain forms of exercises yield more valid results than do others," thus seeming to indicate a contrary point of view, but he goes on to say: "In general it appears that at least all the more commonly used forms of the new examination differ so little in regard to validity that it need not be considered as a factor in selecting the type to be used."³⁸

Tiegs says: "In general, so far as measurement techniques permit us to determine, true-false, multiple choice, and completion tests measure approximately the same thing," and in another place, "Evidence available indicates that the three most used types of new-type tests are approximately equal in validity."³⁹

37. Ruch, G. M. op. cit. p. 290

38. Odell, C. W. op. cit. p. 249

39. Tiegs, E. W. "Tests and Measurements for Teachers
Houghton Mifflin & Co. N.Y. 1931 pp.251,252

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used types of new-type tests are approximately equal

in validity." 38

37. Ruch, G. W. op. cit. p. 230
38. Ogden, G. W. op. cit. p. 249
39. Tiers, E. W. "Tests and Measurements for Teachers"
Houghton Mifflin & Co., N. Y. 1931 pp. 231, 232

This assumption, Magill⁴⁰ states in his report made in January, 1934, seems to be based on two types of evidence, one the similarity in size of coefficients of correlation between alternate test forms made up of test items of the various types and certain criteria of validity; the other, high intercorrelation between alternate test forms. The writer of the article goes on to say that he has been skeptical of the assumption for the following reasons: "first, recall, multiple response and true-false items apparently require greatly dissimilar types and degrees of recall; second, the criteria employed in the studies of comparative validities have been various combinations of essay type examinations, objective type examinations, instructors estimates, pupils' estimates, and terms grades, all academic and questionable substitutes for the life values which supposedly form the objectives of present-day education."

Magill's investigation consisted of three forms of a miscellaneous information test⁴¹

40. Magill, W. H. The Influence of the Form of Item on the Validity of Achievement Tests
Journal of Educational Psychology
 January, 1934.

41. Toops, H.A. Trade Tests in Education Teachers College
Contribution to Education No. 115
 Columbia University, New York, 1921

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of fifty items given to two classes, made up chiefly of teachers-in-service, the first forty-four and the second fifty-four in number.

The first form of the test contained the fifty items in one word answer form (completion), the second contained the same items in five-response form (multiple choice), and the third the same items in true-false form. The three forms were given in the order named, one immediately following the other, and so supervised that there was no opportunity for the subjects to learn the answers during the test period (other than through the incidental practice effect of the tests themselves). The tests were given to class one as speed tests, with limits of seven, five and three minutes respectively which permitted only a few of the most rapid to finish. All members of class two were given sufficient time to finish each test and each, as he finished, noted the time of finishing. The median for each of the tests was as follows:

Recall	8:05 minutes
Five-response	4:30 "
True-false	2:40 "

Intercorrelations between gross

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Recall	8:05 minutes
Five-response	4:30 "
True-false	3:40 "

Interrelationships between Gross

scores were calculated and the responses of each subject to each item of the three forms were compared to determine the number of inconsistencies of response; i.e., responses correct on one form and incorrect on another.

To secure evidence regarding the influence of corrections for chance upon intercorrelations, the intercorrelations obtained with uncorrected scores were compared with those obtained with the scores of the multiple response and true-false lists corrected by the formula $\frac{R-W}{n-2}$. If the inconsistencies were appreciably due to guessing the intercorrelations should be proportionately raised by the corrections for chance.

	Class 1	Class 2
Recall-True-false uncorrected	.61 \pm .06	.76 \pm .04
" " " R-W	.52 \pm .07	.84 \pm .02
Recall-Five-response uncorrected	.88 \pm .02	.91 \pm .01
" " " R- $\frac{1}{4}$ W	.85 \pm .01	.90 \pm .01
Five-response True-false "	.60 \pm .06	.91 \pm .01
" R- $\frac{1}{4}$ W - " R-W	.72 \pm .04	.85 \pm .02

It is noted that four of the six coefficients are reduced in size and two are increased and that each of the increases is paralleled by a corresponding reduction in the other class. There

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relations, the intercorrelations obtained with uncorrected scores were compared with those obtained with the scores of the multiple responses and true-false items corrected by the formula $\frac{p-q}{n-1}$. If the inconsistencies were appreciable due to guessing the intercorrelations should be proportionately raised by the corrections for chance.

Class 1		Class 2	
Recall-True-false uncorrected	.61 \pm .06	Recall-True-false uncorrected	.61 \pm .06
" " " " " "	.52 \pm .07	" " " " " "	.52 \pm .07
Recall-True-false uncorrected	.61 \pm .06	Recall-True-false uncorrected	.61 \pm .06
" " " " " "	.52 \pm .07	" " " " " "	.52 \pm .07
True-false uncorrected	.61 \pm .06	True-false uncorrected	.61 \pm .06
" " " " " "	.52 \pm .07	" " " " " "	.52 \pm .07

It is noted that four of the six

coefficients are reduced in size and two are increased and that each of the increases is paralleled by a corresponding reduction in the other class. There

is no evidence, therefore, that the effect of the inconsistencies can be reduced by corrections for guessing.

Magill draws the following conclusions from his experiment:

1. High intercorrelations may be accompanied by high percentages of inconsistency in the response to specific items;
2. The percentage of inconsistency is widely variable in size and also varies inversely with the gross scores, so that it cannot be considered to be due to the influence of constant factors, which might be eliminated by statistical treatment of the score; and
3. Influence of the inconsistency in response upon the gross scores is not consistently reduced by correcting the scores for chance.

He concludes that test constructors are on safer ground when they strive to so select and use test item forms that they represent direct measures of the items of mental attainment under measurement than when they use the forms indiscriminately under assumptions of equivalence in validity.

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Wegell draws the following conclusions:

from his experiment:

1. High intercorrelations may be

accompanied by high percentages of inconsistency in the response to specific items;

2. The percentage of inconsistency

is widely variable in size and also varies inversely with the gross score, so that it cannot be considered to be due to the influence of constant factors, which might be eliminated by statistical treatment of the score; and

3. Influence of the inconsistency

in response upon the gross score is not consistently reduced by correcting the scores for chance.

He concludes that test constructors

are on safer ground when they strive to select and use test items from that they represent direct measures of the items of mental attainment under measurement than when they use the form indicators. Invalidly under assumptions of equal validity.

There is no doubt that the measurement of the validity of each type of objective test presents one of the most important problems for research. The difficulty in determining validity lies in the selection of an adequate criterion of success in the subject. Various studies have used different criteria and their findings must be considered in relation to the adequacy of these criteria.

The researches in this field have been summarized by Lee and Symonds who have drawn the following conclusions as regards the validity of the various types of objective tests:⁴²

1. Objective tests with the exception of the true-false tests seem to be slightly more valid than the essay examination;
2. Completion test is superior as far as validity is concerned to other types of objective tests;
3. True-false tests appear to be the least valid objective type, but modified forms of it increase its validity;

42. Lee, J. Murray and Symonds, Percival M. New Type or Objective Tests: A Summary of Recent Investigations Journal of Educational Psychology January 1933

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3. True-false tests appear to
be the least valid objective type, but modified
forms of it increase its validity;

4. Objective tests correlate higher than do essay examinations.

The reliability of a test is second only to validity as a criterion of the worth of a test. Symonds believes that "It is perhaps as hard to construct a test with the desired reliability as it is to construct one with high validity."⁴³ Reliability may be defined as "the degree to which scores made upon a test at one time agree with scores made by the same pupils upon the same test at another time. The expression 'same test' should be interpreted to include not merely an identical test, but also a similar and duplicate test."⁴⁴

Since in most cases but one form of test is available, the practical method of determining reliability is to divide any test into two equivalent halves. This may be done by considering all of the odd numbered items as one test and all of the even numbered items as a second test. The coefficient of correlation between the scores of many students on the odd numbered items and the scores of the same students on the even numbered

43. Symonds, P. M. Measurement in Secondary Education

44. Odell, C. W. op, cit. p. 41

p. 287

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scores of the same student on the even numbered

43. Synge, F. W. Measurement in Secondary Education

44. Gull, E. W. op. cit. p. 41

items is then determined.

Toops⁴⁵ has studied the reliability of new-type tests using two different methods with results as follows:

1. Reliability of halves, 124 cases (2 forms of 25 statements each):
2. Reliability of two 50-question sets (Brown's formula):

Recall	Recognition	True-False
.448	.385	.340
.618	.556	.507

In order of decreasing reliability, the tests stand in the order of recall, recognition, and true-false.

Ruch and Stoddard⁴⁶ experimented with a 100-information item test covering the general field of history and the social sciences, suitable in difficulty for twelfth-grade pupils. These items were next divided by chance into two approximately equal "forms" designated as Form A and Form B. The items were then adapted to each of the following five types with the subsequent results:

45. Toops, H. A. Trade Tests in Education

46. Ruch and Stoddard, op. cit..

items as then determined.

Toopa⁴⁵ has studied the reliability of new-type tests using two different methods with results as follows:

1. Reliability of halves, 184 cases (2 forms of 22 statements each):
2. Reliability of two 50-question sets (Brown's formula):

Recall	Recognition	True-False
.448	.388	.340
.618	.532	.377

In order of decreasing reliability, the tests stand in the order of recall, recognition and true-false.

Ruch and Stoddard⁴⁶ experimented with a 100-item test covering the general field of history and the social sciences, suitable in difficulty for twelfth-grade pupils. These items were next divided by chance into two approximately equal "forms" designated as Form A and Form B. The items were then adapted to each of the following five types with the subsequent results:

45. Toopa, H. A. Tests in Education
46. Ruch and Stoddard, *op. cit.*

<u>Type</u>	<u>Form A versus B</u>	<u>Reliability of 100 items by Spearman Brown Formula</u>
Recall	.81 \pm .010	.90
5 Response	.80 \pm .021	.89
3 Response	.60 \pm .037	.75
2 Response	.74 \pm .027	.85
True-false	.56 \pm .040	.71

In order to keep practice effects at as nearly a minimum as possible, it seemed inadvisable on the part of the experimenters to have each pupil take the two forms in all five ways. For this reason all pupils were given the recall type Form A followed directly by Form B, and then one day later were given the same items in one other type-form. The experiment involved more than 500 pupils; sub-groups used for statistical purposes, totalling 135, were random samplings of the larger group.

There is close agreement between this study and that of Toops.

In the summary of researches made in this field and mentioned before in the matter of validity, the following conclusions have been drawn by Lee and Symonds:

1. Objective tests have higher

Reliability of
100 items by
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Form A versus B

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Recall	.815.010	.90
5 Response	.801.081	.83
5 Response	.807.087	.78
5 Response	.741.087	.88
True-false	.882.040	.71

In order to keep practice effects

at as nearly a minimum as possible, it seemed

inadvisable on the part of the experimenters to

have each pupil take the two forms in all three ways.

For this reason all pupils were given the recall

type Form A followed directly by Form B, and then

one day later were given the same items in one

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Forming 135, were random samplings of the larger

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There is close agreement between

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In the summary of researches made

in this field and mentioned before in the matter

of validity, the following conclusions have been

drawn by Lee and Symonds:

1. Objective tests have higher

reliability than essay examinations;

2. Modified true-false tests have a higher reliability than does the usual true-false test.

STATEMENT OF THE PROBLEM TREATED

Students are quite positive that the mimeographed true-false test is "fairer" than the oral test. By this is meant, they feel they can produce a higher score by the reading method than by the listening method.

It is felt that more specific training should be given listening ability in our schools. However, listening ability may never receive the proper emphasis in the schools until we place more of a premium upon it in our examinations.

Necessity of placing stress on this ability is revealed by Rankin.⁴⁷ His data show frequency of use with respect to several types of communicative ability. The study reveals 42% of the "waking time" is spent in listening,

47. Rankin, Paul T. Listening Ability Ohio State University, Vol. 34, 172-183
Sept. 15, 1929

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Necessity of listening stress on
this ability is revealed by Remick.¹ His data
show frequency of use with respect to several
types of communicative ability. The study reveals
15% of the "waiting time" is spent in listening.

47. Remick, Paul F. Listening Ability Ohio State
University, Vol. 34, 1932-33
Sept. 18, 1933

32% in talking, 15% in reading, and 11% in writing. Listening occupies almost three times as much activity as reading.

Lehman⁴⁸ presents objective data that appear contradictory to popular opinion. His study signified that the results obtained by the listening method correlate with the reading method as much as the results from the latter method correlate with themselves; i.e., the listening method produces virtually as consistent results as the reading method. Then again students have the conviction that they make many more errors by the listening method than by the reading method.

Lehman's data, on this point, collide with popular prejudice. By a study of 27,969 answers on true-false statements, he found that 25.15% of the errors were made on the reading and 24.74% by the listening method. From his study, we might conclude that the listening method produces substantially the same results as the reading method.

In his experiment, two modes of presentation were used, the oral and the reading.

48. Lehman, H. C. The Oral Versus the Mimeographed True-False School and Society
Vol. 30:479-472 October 1929

224 in talking, 154 in reading, and 114 in writing.
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Lehman's data, on this point, coincide with popular prejudice. By a study of 87,989 answers on true-false statements, he found that 22.15% of the errors were made on the reading and 24.74% by the listening method. From his study, we might conclude that the listening method produces substantially the same results as the reading method. In his experiment, two modes of presentation were used, the oral and the reading.

The test consisted of eighty-five true-false statements given to nine classes in educational psychology. The statements were first presented orally within a twenty-five minute period. This presentation was followed immediately by the distribution of mimeographed copies of the identical set of eighty-five true-false statements. Lehman states that "since the oral presentation preceded the mimeographed presentation, it seems unlikely that the order of presentation prejudiced the quiz results in favor of the oral presentation."

Average coefficients of correlation for the nine classes were as follows:

Mimeographed odds versus mimeographed evens -	.472
Oral odds versus oral evens	.512
Oral odds versus mimeographed evens	.439
Oral evens versus mimeographed odds	.489

Comparison of the first two correlations reveals that the coefficient is slightly higher for the oral than for the mimeographed presentation. Although this difference is of negligible magnitude, it reveals nevertheless that for the study reported the oral presentation was no less reliable than the mimeographed presentation.

In comparing the third and fourth

The test consisted of eighty-five true-false statements given to nine classes in sequential psychology. The statements were first presented orally within a twenty-five minute period. This presentation was followed immediately by the distribution of mimeographed copies of the identical set of eighty-five true-false statements. Lehman stated that "since the oral presentation preceded the mimeographed presentation, it seems unlikely that the order of presentation prejudiced the quiz results in favor of the oral presentation."

Average coefficients of correlation

for the nine classes were as follows:

Mimeographed odds versus mimeographed evens - .473
Oral odds versus oral evens .312
Oral odds versus mimeographed evens .433
Oral evens versus mimeographed odds .433

Comparison of the first two correlations

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In comparing the third and fourth

correlations, intercorrelations were as large as the self-correlations.

In harmony with Lehman's findings, Jensen's study reveals that virtually the same results are obtained by the listening method as by the reading method. There was a slight advantage of the reading method over the reading-listening method. In Jensen's experiment⁴⁹ three presentations were given to nine classes all within the same period; visual, oral, and visual-oral (the instructor read statements to the class simultaneously with their reading from and recording their responses on mimeographed sheets). The nine classes consisted of three in beginning psychology and six in freshmen college English. The examination consisted of fifty statements in each instance. Jensen states that practice effects were controlled by using three classes in the same subject under the same instructor and varying the order of presentation of the examination so that equal amounts of practice would accrue to each method.

As a further control, equal numbers

49. Jensen, Milton B. An Evaluation of Three Methods of Presentation of True-False Examinations
Vol. 32 School and Society 675-677

correlations, intercorrelations were as large as the self-correlations.

In harmony with Langer's findings,

Langer's study reveals that virtually the same results are obtained by the listening method as by the reading method. There was a slight advantage of the reading method over the reading-listening method. In Langer's experiment, 49 three presentations were given to nine classes all within the same period: visual, oral, and visual-oral (the instructor read statements to the class simultaneously with their reading from and recording their responses on misgraphed sheets). The nine classes consisted of three in beginning technology and six in freshmen college English. The examination consisted of fifty statements in each instance. Langer states that practice effects were controlled by using three classes in the same subject under the same instructor and varying the order of presentation of the examination so that equal amounts of practice would accrue to each method. As a further control, equal numbers

of papers were taken (at random) from each of the classes, that is, twenty-five from each of the psychology classes and thirty from each of the English classes, making a total of 255 papers.

Jensen found a slightly higher correlation with the oral over the visual (in harmony with Lehman's findings) and of the visual over the visual-oral (a comparison Lehman did not make).

The coefficients for each of the three methods of presentation were as follows:

	Visual	Oral	Visual-Oral
Psychology	.59 \pm .05	.63 \pm .05	.51 \pm .06
English Group I	.87 \pm .01	.83 \pm .01	.86 \pm .01
English Group II	.82 \pm .01	.88 \pm .01	.82 \pm .01

The superior accuracy of the English over the psychology examination may be partially accounted for by its shorter statements and greater definiteness--it consisted of sentences to be marked as to correctness of punctuation; the psychology examination was built to cover the concepts treated in certain chapters of the test used by the students.

of papers were taken (at random) from each of the classes, that is, twenty-five from each of the psychology classes and thirty from each of the English classes, making a total of 235 papers. Jensen found a slightly higher

correlation with the oral over the visual (in harmony with Lehman's findings) and of the visual over the visual-oral (a comparison Lehman did not make).

The coefficients for each of the

three methods of presentation were as follows:

	Visual	Oral	Visual-Oral	
Psychology	.831.05	.821.05	.811.05	
English Group I	.871.01	.851.01	.861.01	
English Group II	.821.01	.861.01	.831.01	

The superior accuracy of the English

over the psychology examination may be partially accounted for by its shorter statements and greater definiteness--it consisted of sentences to be marked as to correctness of punctuation; the psychology examination was built to cover the concepts treated in certain chapters of the text used by the students.

In Stump's study,⁵⁰ data were obtained from five classes in first-year college subjects, thereby securing a total of 7,363 reactions. The five classes consisted of three classes of Normal School pupils, two in Elementary Tests and Measurements, 27 and 22 pupils respectively, and one in Elementary Educational Psychology, 37 pupils; the two college classes consisted of 23 pupils each in High School Tests and Measurements.

An oral true-false test was given at the end of the third week of study in each class. A week following the first test, the experimenter presented the same statements as before in mimeographed form. The pupils were asked whether they could recall completely any of the statements and a majority stated that not a single statement could be clearly remembered. It may be concluded that the first examination would little, if any, influence the results on the second.

The average coefficient of correlation between the reading scores and the oral scores was .47; accordingly, Stump states that this

50. Stump, N. F. Oral Versus the Printed Method in the Presentation of the True-False Examination Journal Educational Research Vol. 18:423-4 D'28

In Stump's study, 50 data were obtained from five classes in first-year college subjects, thereby securing a total of 5,000 responses. The five classes consisted of three classes of Normal School pupils, two in Elementary Tests and Measurements, 27 and 28 pupils respectively, and one in Elementary Educational Psychology, 27 pupils; the two college classes consisted of 23 pupils each in High School Tests and Measurements. An oral true-false test was given

at the end of the third week of study in each class. A week following the first test, the experimenter presented the same statements as before in mimeographed form. The pupils were asked whether they could recall completely any of the statements and a majority stated that not a single statement could be clearly remembered. It may be concluded that the first examination would little, if any, influence the results on the second.

The average coefficient of corre-

lation between the reading scores and the oral scores was .47; accordingly, Stump states that this

degree of correlation would indicate that the extra time spent in mimeographing examinations was not justified.

Crawford⁵¹ states that in work done to determine whether true-false tests measure student knowledge as well when presented orally as when presented in mimeographed form, the results have generally shown that the oral method is as good as the mimeographed method. Student reaction to the oral method, however, is often unfavorable, with the result that class morale or teacher-pupil harmony sometimes suffers if the oral method is used extensively.

Some students are firmly and unalterably opposed to the oral method and persist in classifying themselves as martyrs when they are so tested.

One hundred twenty University students were given two tests, one oral and one mimeographed. Each test consisted of fifty statements and they were alternate forms of a test prepared by the author of the textbook used. No

51. Crawford, C. C. Preference Versus Performance in Taking Oral True-False Tests
School Review 40:138-41 F'32

degree of correlation would indicate that the
extra time spent in micrographing examinations
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prepared by the author of the textbook used. No

⁵¹ Crawford, C. R. Preference Versus Performance in
Taking Oral Versus Micrographed Tests
School Review 40, 193-21, 1932

norms were published for the two forms, but it was thought that the tests were more nearly standardized for equal difficulty than are the usual, informal, teacher-made tests.

Scores tabulated according to whether each student did better by the oral, by the mimeographed, or by neither method. Thus a student might prefer the oral method but actually do better on the mimeographed form, or he might have no preference and actually do better on the oral part and so on.

The distribution of the preferences and of the performance was:

42	students	preferred	the mimeographed	method
43	"	"	the oral method	
35	"	"	neither method	
120				

This vote was taken after the class had had considerable experience with both methods.

The coefficient of correlation $.08 \pm .06$ (with a standard error of $.09$) best summarizes the extent of the relation. This coefficient is so low that it may be interpreted

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The Distribution of the Preference

Mean and of the preference was:

42 students preferred the mimeographed method				
42	"	"	"	"
38	"	"	"	"
120				

This vote was taken after the

class had had considerable experience with both methods.

The coefficient of correlation

.08105 (with a standard error of .02) best summarizes the extent of the relation. This coefficient is so low that it may be interpreted

as no correlation at all. In other words, students' notions as to which methods give them the best scores are of no value whatever as indications of the real facts of the case.

This investigation reveals no reason why faith should be placed in students' judgments of the relative values of the oral method and the written method of presenting true-false tests, since preferences and performances show no correlation that cannot be ascribed to mere chance.

In the writer's experiment, the problem is attacked from a different point of view. In neither Lehman's or Jensen's study were abilities as measured by mental tests taken into consideration. In this study, the index of "fairness" of each method is regarded in relation to the learning ability as measured by mental ability tests.

In terms of the ideal, assuming that pupils do justice to themselves, those with good ability should make good scores, those with average ability average marks, and those with poor ability poor marks, especially when objective examinations which minimize the personal element in grading are administered.

as no correlation at all. In other words, students' notions as to which methods give them the best scores are of no value whatever as indications of the real facts of the case.

This investigation reveals no reason why truth should be placed in students' judgments of the relative values of the oral method and the written method of presenting true-false tests, since preferences and performances show no correlation that cannot be ascribed to mere chance. In the writer's experiment, the problem is attacked from a different point of view. Is either Lehman's or Jensen's study more efficient as measured by mental tests taken into consideration. In this study, the index of "fairness" of each method is regarded in relation to the learning ability as measured by mental ability tests.

In terms of the ideal, assuming that pupils be justice to themselves, those with good ability should make good scores, those with average ability average marks, and those with poor ability poor marks, especially when objective examinations which minimize the personal element in grading are administered.

DESCRIPTION OF THE EXPERIMENT

The purpose of the writer's experiment is to present data upon this problem, listening versus reading of true-false tests, which continues to attract considerable attention.

In all the researches studied, all the experiments were found to have been performed in either normal school or college. In no instance found had an experiment been given in high school, and subsequently none was found to have been given in the field of commercial education.

For the writer's experiment, the four classes of twenty-three pupils each in Elementary Bookkeeping were included. Sections in this particular High School are formed the preceding year by the principal, using the Intelligence Quotients of the pupils to form the classes in English. This classification for English determines the grouping in the other subjects. Two of these sections of twenty-three pupils each were designated as Group A and the other two sections as Group B. The number of pupils included in the experiment totalled ninety-two, largely

second-year pupils in High School, with a few third-year pupils.

Statements used in the examination were taken from two sources: Elwell-Fowlkes Bookkeeping Test I, Form A and Form B; the Carlson Bookkeeping Tests 1, 2, 3, and 4.

The Elwell-Fowlkes tests are intended primarily for measuring general achievement and are not based on any specific textbook. Test I, referred to above, is intended to cover the first semester of Bookkeeping.

Each of the Carlson Tests is an objective test based upon a complete analysis of a definite section of the textbook, "20th Century Bookkeeping and Accounting": Test 1 is based upon material from Chapter I to Chapter IV inclusive; Test 2, upon Chapter V to Chapter VII; Test 3, upon Chapter VIII and Chapter IX; Test 4, Chapter X to XV.

In listing the statements taken from the Elwell-Fowlkes Test, those concerning principles which had not been taught to the pupils up to the time of the experiment (March, 1934)

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Test 3, upon Chapter VIII and Chapter IX; Test 4,

Chapter X to XV.

In listing the statements taken

from the Elwell-Powles test, those concerning

principles which had not been taught to the pupils

up to the time of the experiment (March, 1924)

were omitted.

The following, taken from Page 2,
Form B, is shown by way of illustration:

1. The total of all the debits as recorded in the ledger accounts should equal the total of all the credits.
2. The cost of merchandise sold is always the difference between the total merchandise sales and the total merchandise purchases.
3. The debits in a book of original entry are posted as credits in the ledger.
4. A net profit increases the proprietary interest (proprietorship).
5. A credit balance in the Proprietor's Drawing (Personal) account at the close of the first period in business indicates that the net profit is in excess of the withdrawals.
6. When an interest-bearing note is given in payment of an account, Notes Payable and Interest Expense (Interest Cost, Interest Paid) are credited.
7. A debit balance in the Notes Receivable account indicates that all notes received have not been paid.
8. A separate posting to the Cash account is made for each item in the cash journal (cash book).

were omitted.

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1. The total of all the debits as recorded in the ledger accounts should equal the total of all the credits.
2. The cost of merchandise sold is always the difference between the total merchandise sales and the total merchandise purchases.
3. The debits in a book of original entry are posted as credits in the ledger.
4. A net profit increases the proprietary interest (proprietary).
5. A credit balance in the proprietor's drawing (personal) account at the close of the first period in business indicates that the net profit is in excess of the withdrawals.
6. When an interest-bearing note is given in payment of an account, Notes Payable and Interest Expense (Interest Cost, Interest Paid) are credited.
7. A debit balance in the Notes Receivable account indicates that all notes received have not been paid.
8. A separate posting to the Cash account is made for each item in the cash journal (cash book).

9. The entry to record the receipt of a note from a customer is made in the general journal (journal).
10. The closing entries for a business are usually made at the end of each fiscal period.

Numbers 1, 2, 3, 7, 8, 9, and 10 were included. Number 4 was omitted because it was similar to a statement already taken from Form A (Form A and Form B as stated by the publishers were supposed to be alike in organization and almost equal in difficulty, differing only in specific content). In regard to the omission of statement No. 5, while the particular account mentioned had been taught, the method of handling it differed and the pupils would have been unable to answer it. The material included in statement No. 6 had not been taught at the time and would not be taught, according to the outline of the course, until May.

After the material in the Elwell-Fowlkes test was exhausted, the balance of the statements used was taken from the Carlson Tests; the reason for this procedure being that the Elwell-Fowlkes test covered general information,

9. The entry to record the receipt of a note from a customer is made in the general journal (journal).

10. The closing entries for a business are usually made at the end of each fiscal period.

Numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10

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After the material in the Elwell-

Powles test was exhausted, the balance of the statements used was taken from the Carlson Tests; the reason for this procedure being that the Elwell-Powles test covered general information.

while the Carlson tests covered specific information contained in definite chapters of the textbook used in class, much of which at the time of the examination was "old material" to the pupils.

For example, in Test I, covering Chapters I to IV, statements which referred to subject-matter taught in November and which had not undergone any change or enlargement were not included because they would have proved too simple and would not have served as good test items. However, statements referring to material also taught in November, but which had been enlarged upon since then, thus requiring some thought in answering, were included.

The following taken from Carlson Test I will illustrate the above paragraph:

11. All increases in Assets are recorded in some asset account as credits.
12. All increases in Proprietorship are recorded in the account with the proprietor as debits.
13. All increases in Income are recorded in some income account as debits.

while the Carlson tests covered specific information contained in definite chapters of the textbook used in class, much of which at the time of the examination was "old material" to the pupils.

For example, in Test I, covering Chapters I to IV, statements which related to subject-matter taught in November and which had not undergone any change or enlargement were not included because they would have proved too simple and would not have served as good tests. However, statements referring to material also taught in November, but which had been enlarged upon since then, thus requiring some thought in answering, were included.

The following taken from Carlson

Test I will illustrate the above paragraphs:

11. All increases in assets are recorded in some asset account as credits.
12. All increases in proprietorship are recorded in the account with the proprietor as debits.
13. All increases in income are recorded in some income account as debits.

14. All increases in Expense are recorded in some expense account as credits.
15. All cash receipts are recorded in the cash account as debits.
16. All cash payments are recorded in the cash account as credits.
17. All of the proprietor's investments in the business are recorded in his account as debits.
18. All sales are recorded in the sales account as credits.
19. All purchases are recorded in the purchases as debits.
20. All expenses are recorded in some expense account as credits.

Numbers 11, 12, 16, 19, and 20 were included and the remaining numbers omitted for reasons given above.

The total number of statements included in the experiment was 100. Symonds says "In general true-false tests are not very reliable unless one hundred or more statements are included."⁵² Ruch in discussing the objective examination in regard to length says, "Long tests may be expected to be more valid than short tests

52. Ruch, G. M. The Objective or New-Type Examinations New York: Scott, Foresman & Company, 1929. p. 39

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20. All expenses are recorded in
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18. All sales are recorded in the
 sales account as credits.
17. All of the proprietor's invest-
 ments in the business are recorded
 in his account as debits.
16. All cash payments are recorded
 in the cash account as credits.
15. All cash receipts are recorded
 in the cash account as debits.
14. All increases in expenses are
 recorded in some expense account
 as credits.

and if a test is made long enough, it will usually yield a reasonably valid measure even if many individual items are faulty or worthless."⁵³

In regard to the validity and reliability of the Elwell-Fowlkes Tests, the following appears in their Manual of Directions:

"Because of the large number of questions and the variety of informational items involved, the test is much more reliable and valid than the customary final examination in bookkeeping. Also the tests cover the material and activities offered throughout the country during the first year of bookkeeping. The reliability correlation between Form A and Form B is, for Test 1, $.821 \pm .013$."

In regard to the validity and reliability of the Carlson Tests, Mr. Carlson in an article on "What Is a Good Test in Business Education?" in the Balance Sheet, May, 1932, quotes Symond's and Ruch and Stoddard's theory of validation (which have already been included in this thesis in connection with the subject of validity) and goes on to say that "It is evident from the foregoing

53. Symonds, Percival M. Measurement in Secondary Education Macmillan Co. 1930
p. 27

and if a test is made long enough, it will usually yield a reasonably valid measure even if many individual items are faulty or worthless." 23

In regard to the validity and reliability of the Kewell-Powles Tests, the following appears in their Manual of Instructions:

"Because of the large number of questions and the variety of informational items involved, the test is much more reliable and valid than the customary final examination in bookkeeping. Also the tests cover the material and activities offered throughout the country during the first year of bookkeeping. The reliability correlation between Form A and Form B is, for Test 1, .821±.012."

In regard to the validity and reliability of the Garison Tests, Mr. Garison in an article on "What is a Good Test in Business Education?" in the Balance Sheet, May, 1932, quotes Symonds' and Koch and Stoddard's theory of validity (which have already been included in this thesis in connection with the subject of validity) and goes on to say that "It is evident from the foregoing

discussion that we may construct tests which are valid for a single textbook or we may construct tests which are valid for a course of study."

Each of the Carlson tests is an objective test based upon a complete analysis of a definite section of the sixteenth edition of the sixteenth edition of 20th Century Bookkeeping and Accounting--the textbook used by the aforementioned ninety-two pupils.

The coefficients of reliability are the coefficients of correlation between the odd and even items, corrected according to the Spearman-Brown Formula and are as follows: Test 1--.895; Test 2--.937; Test 3--.939; Test 4--.918; Test 5--.896. In computing these coefficients, a limited number of papers were used. The groups of papers were selected at random, but in each case all papers in one group or class were included.

Both the Elwell-Fowlkes and Carlson tests consist of completion, multiple-choice, matching, and true-false items. It has been stated in the discussion on reliability that in order of decreasing reliability, the various types of objec-

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the textbook used by the aforementioned ninety-two
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The coefficients of reliability
are the coefficients of correlation between the
odd and even items, reported according to the
Spearman-Brown formula and are as follows:
Test 1--805; Test 2--837; Test 3--886; Test 4--918;
Test 5--886. In computing these coefficients,
a limited number of papers were used. The groups
of papers were selected at random, but in each case
all papers in one group or class were included.
Both the R-squared formula and
Carlson tests consist of comparison, multiple-choice,
matching, and true-false items. It has been stated
in the discussion on reliability that in order of
decreasing reliability, the various types of objec-

tive tests stand in the order of recall, recognition, and true-false. This will account for the lower correlation found in this experiment between the odd and even items of the true-false test as compared with the high correlations of both the Elwell-Fowlkes and Carlson Tests.

The test was first presented to a group of twenty-five students in Advanced Book-keeping for the purpose of determining the scale of difficulty. The one hundred statements were then re-arranged according to frequency of errors (as listed on Pages *77-83*). They were divided into two groups of fifty each, the odds, 1-99, and the evens, 2-100. The odds, 1-99, were presented orally to Group A and on mimeographed sheets to Group B; the evens, 2-100, were presented orally to Group B and on mimeographed sheets to Group A. *Indicated by ** The oral tests were presented to Group A and Group B respectively on one day, and the reading tests to Groups A and B respectively the following day. *False statements were to be steadily indicated* The method used by the examiner (the writer) in administering the tests was as

five tests stand in the order of recall, recognition, and true-false. This will account for the lower correlation found in this experiment between the odd and even items of the true-false test as compared with the high correlations of both the Kewell-Bowker and Carlson Tests.

The test was first presented to a group of twenty-five students in advanced Book-keeping for the purpose of determining the scale of difficulty. The one hundred statements were then re-arranged according to frequency of errors (as listed on pages 77-78). They were divided into two groups of fifty each, the odds, 1-50, and the

evens, 51-100. The odds, 1-50, were presented orally to Group A and on mimeographed sheets to Group B; the evens, 51-100, were presented orally to Group B and on mimeographed sheets to Group A.

The oral tests were presented to Group A and Group B respectively on one day, and the reading tests to Groups A and B respectively the following day.

The method used by the examiner (the writer) in administering the tests was as

follows:

In the case of the oral tests, the students were asked (1) to write their names in the upper right hand corner of their ruled sheets of paper;

(2) to write the numbers from 1-25 on one sheet and from 26-50 on the second sheet;

At this point, students were informed that

(1) each statement would be read twice; (the first reading was to assist in orientation, while during the repetition, the pupils could concentrate upon the decision of "True" or "False");

(2) true statements were to be indicated by a plus (+) sign placed at the right of the corresponding number on the sheets of ruled paper;

(3) false statements were to be similarly indicated by the use of a (-) sign; and

(4) no questions would be per-

follows:

In the case of the oral report,

the students were asked

(1) to write their names in the

upper right hand corner of their report sheets of

report;

(2) to write the numbers from

1-25 on one sheet and from 26-50 on the second

sheet;

At this point, students were

informed that

(1) each statement would be read

twice; (the first reading was to assist in orien-

tation, while during the repetition, the pupils

would concentrate upon the decision of "true" or

"false";

(2) true statements were to be

indicated by a plus (+) sign placed at the right

of the corresponding number on the sheets of ruled

paper;

(3) false statements were to be

similarly indicated by the use of a (-) sign; and

(4) no questions would be con-

mitted regarding the reading by the examiner of the true-false statements.

In the experiment, the examiner now read the first true-false statement from her examination paper, pronouncing each word as distinctly as possible. At the conclusion of the first reading, the examiner counted silently and as rapidly as possible from 1 to 10. With no further delay than that involved in counting from 1-10, the examiner then reread the first statement and again counted from 1 to 10 before proceeding to the second statement.

In the reading method, each pupil was furnished the statements so arranged on mimeographed sheets that a line could be drawn under the word "True" or "False" which appeared to the right of each statement. The papers for both presentations were scored by the "number right" formula.

The intelligence quotients for the ninety-two pupils were secured by administering the Otis Self-Administering Test of Mental Ability, Form A.

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The intelligence quotients for
the ninety-two pupils were secured by administering
the Otis Self-Administering Test of Mental Ability.

Form A.

All the coefficients of correlation are handled statistically using the Pearson Product-Moment Method of correlation and the Yule method of Partial Correlation⁵⁴

FINDINGS FROM THE DATA

The relationship between scores made by the listening procedure when correlated with the scores made by the reading method within the respective groups is shown in Table I. The correlations of .64 and .61 are practically identical. This shows that the two groups as individual groups did equally well when both methods of presentation were correlated.

TABLE I
CORRELATION BETWEEN ORAL AND
READING SCORES

Group	No. of Pupils	Odds 1-99	Evens 2-100	R
A	46	Oral	Reading	.64 \pm .06
B	46	Reading	Oral	.61 \pm .06

54. Garrett, H. E., Statistics in Psychology and Education Longmans Green & Co. 1926

of partial correlation
 moment method of correlation and the TSS method
 are handled statistically using the Pearson Product-
 all the coefficients of correlation

FIGURES FROM THE DATA

The relationship between scores
 made by the listening procedure when correlated
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 presentation were correlated.

TABLE I
 CORRELATION BETWEEN ORAL AND
 READING SCORES

Group	No. of Pupils	Odd 1-39	Even 2-40	R
A	40	Oral	Reading	.64100
B	40	Reading	Oral	.61000

By combining Groups A and B, the writer found that the correlation between all the orals and all the readings is .62 as shown in Diagram IX. This shows that in the combination of the two groups, giving a total of 92 cases, the correlation between all the orals and all the readings was practically as large as the correlation between the odds and evens in the separate groups.

When potential ability is considered, it is interesting to note which method of procedure indicates a "fairer" ranking of the pupils.

Under ideal conditions, we would expect those with high potential ability to make high scores, those with low potential ability to make low scores, and those with average ability average scores. We never get this ideal condition, but we can at least state which of these two methods produces the "fairer" ranking of students when potential ability is measured by means of the intelligence quotient.

The coefficient of correlation

By combining Groups A and B, the writer found that the correlation between all the ovals and all the readings is .82 as shown in Diagram IX. This shows that in the combination of the two groups, giving a total of 32 cases, the correlation between all the ovals and all the readings was practically as large as the correlation between the odds and evens in the separate groups.

When potential ability is considered, it is interesting to note which method of procedure indicates a "better" ranking of the pupils.

Under ideal conditions, we would expect those with high potential ability to make high scores, those with low potential ability to make low scores, and those with average ability average scores. We never get this ideal condition, but we can at least state which of these two methods produces the "better" ranking of students when potential ability is measured by means of the intelligence quotient.

The coefficient of correlation

showing this relationship between scores made by the oral procedure and mental ability, also the relationship between scores in the reading method and mental ability for each group are given in Table II.

TABLE II
CORRELATION BETWEEN SCORES AND
INTELLIGENCE QUOTIENT

Group	No. of Pupils	Oral Scores and I. Q.	Reading Scores and I. Q.
A	46	.49 \pm .07 (1-99)	.38 \pm .08 (2-100)
B	46	.34 \pm .09 (2-100)	.45 \pm .08 (1-99)

In the Group A, the correlation between the oral scores and intelligence quotient for the odds (.49) was higher than that of the same statements given by the reading method and the intelligence quotient (.38). In comparing the coefficient of correlation for the B group, the correlation between the reading scores and the intelligence quotient (.45) is higher than the correlation between the oral scores and the

showing this relationship between scores made by the oral procedure and mental ability, also the relationship between scores in the reading method and mental ability for each group are given in

Table II.

TABLE II
CORRELATION BETWEEN SCORES AND
INTELLIGENCE QUOTIENT

Group	No. of Pupils	Oral Scores and I. Q.	Reading Scores and I. Q.
A	48	.49707 (1-99)	.38108 (2-100)
B	48	.54109 (2-100)	.45605 (1-99)

In the Group A, the correlation between the oral scores and intelligence quotient for the odds (.49) was higher than that of the same statements given by the reading method and the intelligence quotient (.38). In comparing the coefficient of correlation for the B group, the correlation between the reading scores and the intelligence quotient (.45) is higher than the correlation between the oral scores and the

intelligence quotient (.34).

In other words, the mental ability of Group A compared more favorably with the oral presentation than with the reading presentation, while in the case of Group B, conditions were the reverse.

It is interesting to note that the correlation of the odd items (1-99) with the mental ability of each group is practically identical for the two presentations; the same is true of the even items, but with a lesser degree of correlation.

The correlation for the combined groups as shown in Table III varies by only one point.

TABLE III

CORRELATION BETWEEN SCORES AND INTELLIGENCE
QUOTIENT FOR THE COMBINED GROUPS

Groups	Variables	R
A and B (92)	I.Q. and all orals	.37 \pm .06
A and B (92)	I.Q. and all readings	.38 \pm .06

Intelligence quotient (.36).

In other words, the mental ability

of Group A correlated more favorably with the oral presentation than with the reading presentation, while in the case of Group B, conditions were the reverse.

It is interesting to note that the correlation of the odd items (1-25) with the mental ability of each group is practically identical for the two presentations; the same is true of the even items, but with a lesser degree of correlation.

The correlation for the combined groups as shown in Table III varies by only one point.

TABLE III

CORRELATION BETWEEN COGNITIVE AND INTELLIGENCE QUOTIENT FOR THE COMBINED GROUPS

Groups	Variables	N
A and B (92)	I.C. and all orals	237.00
A and B (92)	I.C. and all readings	235.00

The similarity between the above correlations signifies that the oral method of presentation tells as true and as "fair" a story of the achievement of the pupils as the reading method does.

The partial correlation for the correlation of $.62 \pm .04$ between all orals and all readings, using the correlations as illustrated in Table III for variables, thus holding intelligence quotient constant, was found to be .56 as shown in Table IV.

TABLE IV
PARTIAL CORRELATION HOLDING
INTELLIGENCE QUOTIENT CONSTANT

r_{12} - Group A and B r -.37 between I.Q.
and all orals

r_{13} - Group A and B r -.38 between I.Q.
and all readings

r_{23} - Group A and B r -.62 between all orals
and all readings

$$r_{23.1} = \frac{r_{23} - r_{12} r_{13}}{\sqrt{1-r_{12}^2} \sqrt{1-r_{13}^2}} = .56$$

The similarity between the above

correlations suggests that the first method of
presentation tells us more and is "fair" a story
of the relationship of the nuclei as the reading
method does.

The partial correlation for the
correlation of .68104 between all orals and all
readings, using the correlations as illustrated
in Table III for variables, thus holding initial-
genes constant, was found to be .55 as
shown in Table IV.

TABLE IV

PARTIAL CORRELATION BETWEEN
INTELLIGENCE QUOTIENT CONSTANT

128 - Group A and B	r = .55 between I.Q. and all orals
129 - Group A and B	r = .55 between I.Q. and all readings
130 - Group A and B	r = .55 between all orals and all readings

$$r_{128-129} = \frac{r_{128-130} - r_{128-129} r_{129-130}}{\sqrt{1 - r_{128-129}^2 - r_{129-130}^2}}$$

The writer was interested to know whether the students made more errors when the true-false test was presented orally than when presented on mimeographed sheets. The total number of errors for each method of presentation was tabulated and percentages figured as shown in Table V.

The number of pupils who preferred the oral method of presentation to the written was found to be 15%, the remaining 85% preferring the mimeographed sheets. This is particularly interesting in view of the results as shown in Table V which shows that the pupils seemed to do as well by the oral as by the reading procedure.

TABLE V
TOTAL NUMBER OF ERRORS
AS EXPRESSED IN PER CENT

Group	Test	No. of Errors	Group	Test	No. of Errors
A (46)	Oral	559	A (46)	Reading	486
B (46)	Oral	498	B (46)	Reading	437
		1057			923
Total number of answers 92 x 100 = 9200					
Errors in % - .11			Errors in % - .10		

The writer was interested to know whether the students made more errors when the true-false test was presented orally than when presented on mimeographed sheets. The total number of errors for each method of presentation was tabulated and percentages figured as shown in Table V.

The number of pupils who repeated the oral method of presentation for the written was found to be 184, the remaining 85% preferring the mimeographed sheets. This is particularly interesting in view of the results as shown in Table V which shows that the pupils seemed to do as well by the oral as by the reading procedure.

TABLE V
TOTAL NUMBER OF ERRORS
AS EXPRESSED IN PER CENT

Group	Test	No. of Errors	Group	Test	No. of Errors
A (48)	Oral	583	A (48)	Reading	483
B (48)	Oral	493	B (48)	Reading	437
Total number of answers 92 x 100 = 9200					
Errors in % - 11					
Errors in % - 10					

Inasmuch as the coefficient of correlation ($.62 \pm .04$) between the entire test given orally and the entire test given by the reading method is as high as the correlation of the test itself, (.64 and .61) it may be safely concluded that, in so far as the present study is concerned, the oral and the mimeographed presentation measured identical abilities and that they measured these abilities with approximately equal effectiveness.

This study, however, does not purport to show that the oral presentation is equally fair to every pupil. Neither mode of presentation will enable every student to make his best possible showing since a few pupils are likely to be handicapped by inferior hearing ability and a few others are likely to be handicapped by inferior reading ability.

While the oral true-false test would avoid the labor and expense involved in mimeographing true-false examinations, there are other factors to be considered. Undoubtedly, some instructors would not read distinctly enough to

Inasmuch as the coefficient of correlation (.82) between the entire test given orally and the entire test given by the reading method is as high as the correlation of the test itself (.84 and .85) it may be safely concluded that, in so far as the present study is concerned, the oral and the mimeographed presentation measured identical abilities and that they measured those abilities with approximately equal effectiveness.

This study, however, does not purport to show that the oral presentation is equally fair to every pupil. Neither mode of presentation will enable every student to make his best possible showing since a few pupils are likely to be handicapped by inferior hearing ability and a few others are likely to be handicapped by inferior reading ability.

While the oral true-false test would avoid the labor and expense involved in mimeographing true-false examinations, there are other factors to be considered. Undoubtedly, some instructors would not read distinctly enough to

be understood when directing the examination and some would read the statements so as to "point" the answers.

The oral presentation revealed that the oral test as given afforded the following advantages:

(1) When each statement is read twice, the rapid count from 1-10 provides sufficient time for students to recognize and to indicate its truth or its falsity;

(2) Since the students know in advance that no statement will be read more than twice, they make a sincere effort to understand the first reading;

(3) The uniform length of the pauses between statements permits the students to anticipate accurately the reading of successive statements and they are then enabled to concentrate maximum attention in the direction of the examiner at the appropriate moment;

(4) The above plan also permits the students brief intervals of more or less complete relaxation. Both time and energy are thus

be understood when discussing the examination and
each would read the statements in as to "right
the answers."

The oral presentation revealed
that the oral test as given afforded the following
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twice, they make a sincere effort to understand
the first reading.

(3) The uniform length of the
pauses between statements permits the students to
anticipate accurately the reading of successive
statements and they are then enabled to concentrate
maximum attention in the direction of the examiner
at the appropriate moment.

(4) The above plan also permits
the students brief intervals of rest or less con-
stant relaxation. Both time and energy are thus

conserved.

Further investigation is essential to the solution of this problem if we are to shape our testing procedures in conformity with individual differences appearing in the amount that a student "knows" when the same examination stimuli are presented by different methods. Until such investigations are made, the oral method of presenting true-false examinations may be considered as effective as the visual, and considerably more desirable, because of the resultant economy in both time and money.

conserved.

Further investigation is essential to the solution of this problem if we are to improve our testing procedures in conformity with radiological differences appearing in the amount that a student "knows" when the same examination is administered by different methods. Until such investigations are made, the oral method of testing true-false examinations may be considered as effective as the visual, and considerably more desirable, because of the greatest economy in both time and money.

TEST

1. A net loss in the business increases the proprietorship. True False
2. The purpose of the Trial Balance is to prove the equality of debits and credits. True False
3. A decrease in the asset cash is debited to the Cash Account. True False
4. A debit in the Rent Expense account indicates a payment for the use of store or office. True False
5. The left side of any account is used to record credits. True False
6. The transfer of debits and credits from the books of original entry to the ledger is called posting. True False
7. The difference between the two sides of an account is called the balance. True False
8. A check received is recorded in the cash receipts side of the Cash Book. True False
9. Proprietorship equals assets minus liabilities. True False
10. Depreciation Reserve account is a liability. True False
11. An investment in a business made by a proprietor is credited to his capital account. True False
12. The excess of debits in the Cash account over the credits shows cash on hand. True False
13. The adjusting and closing entries at the end of a period are recorded in the General Journal. True False
14. Errors in addition or subtraction of an account in the Ledger are revealed by the Trial Balance. True False

TEST

1. A net loss in the business increases the proprietorship. True False
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12. The excess of debits in the Cash account over the credits shows cash on hand. True False
13. The adjusting and closing entries at the end of a period are recorded in the General Journal. True False
14. Errors in addition or subtraction of an account in the ledger are revealed by the Trial Balance. True False

15. It is customary to rule the account with a charge customer when it is in balance. True False

16. The exchange of one asset for another of equal value does not affect the proprietorship account. True False

17. The list of merchandise on hand at any time is referred to as Merchandise Inventory. True False

18. The journal is a book of original entry. True False

19. The number of the page of the Journal from which a posting is obtained should be entered in the Ledger. True False

20. All asset accounts have credit balances. True False

21. All purchases are recorded in the Purchases Journal. True False

22. The Post-Closing Trial Balance is taken after the Ledger has been closed. True False

23. The account with the proprietor in which his withdrawals of cash and merchandise are recorded is called the Capital account. True False

24. The closing entries for a business are made at the end of each fiscal period. True False

25. The analysis of a business transaction into its debit and credit elements is called journalizing. True False

26. The Sales Account is classified as an expense account. True False

27. The payment of a note payable by the business decreases liabilities. True False

28. Return sales are recorded as credits to the Sales account. True False

29. The payment of rent is recorded in the cash receipts side of the Cash Book. True False

26. The payment of rent is recorded in the cash receipts side of the Cash Book.
True False

27. Return sales are recorded as credits to the Sales account.
True False

28. The payment of a note payable by the business decreases liabilities.
True False

29. The Sales account is classified as an expense account.
True False

30. The analysis of a business transaction into its debit and credit elements is called journalizing.
True False

31. The closing entries for a business are made at the end of each fiscal period.
True False

32. The account with the proprietor in which his withdrawals of cash and merchandise are recorded is called the Capital account.
True False

33. The Post-Closing Trial Balance is taken after the ledger has been closed.
True False

34. All purchases are recorded in the Purchases Journal.
True False

35. All asset accounts have credit balances.
True False

36. The number of the page of the Journal from which a posting is obtained should be entered in the ledger.
True False

37. The Journal is a book of original entry.
True False

38. The list of merchandise on hand at any time is referred to as Merchandise Inventory.
True False

39. The exchange of one asset for another of equal value does not affect the proprietor's equity account.
True False

40. It is customary to rule the account with a charge customer when it is in balance.
True False

30. A correcting entry is usually recorded in the General Journal. True False
31. All expenses are recorded in some expense account as credits. True False
32. A fiscal period is always one month in length. True False
33. All purchases of store fixtures, desks, etc. are debited to the Purchases account. True False
34. The net profit of a period is the sum of the gross profit and the operating expenses. True False
35. Increases in liabilities are credited to the proper liability account. True False
36. The Balance Sheet shows the condition of the business at a definite time. True False
37. A debit balance in the Notes Receivable account indicates that all notes received have not been paid. True False
38. A Trial Balance of the Ledger taken before the books are closed does not differ from a Trial Balance taken immediately after the books are closed. True False
39. In every business transaction, there is an exchange of one value for another. True False
40. The amount of supplies used during a period should be entered in the Profit and Loss Statement as an expense. True False
41. All sales on account are recorded in the Sales Journal. True False
42. When a Note Receivable is paid, it becomes a Note Payable. True False
43. A separate posting to the Cash account is made for each item in the Cash Book. True False
44. An increase in salaries paid decreases proprietorship. True False

30. A correcting entry is usually recorded in the General Journal.
True False
31. All expenses are recorded in some expense account as credits.
True False
32. A fiscal period is always one month in length.
True False
33. All purchases of store fixtures, desks, etc., are debited to the purchases account.
True False
34. The net profit of a period is the sum of the gross profit and the operating expenses.
True False
35. Increases in liabilities are credited to the proper liability account.
True False
36. The Balance Sheet shows the condition of the business at a definite time.
True False
37. A debit balance in the Notes Receivable account indicates that all notes received have not been paid.
True False
38. A Trial Balance of the ledger taken before the books are closed does not differ from a Trial Balance taken immediately after the books are closed.
True False
39. In every business transaction, there is an exchange of one value for another.
True False
40. The amount of supplies used during a period should be entered in the Profit and Loss Statement as an expense.
True False
41. All sales on account are recorded in the Sales Journal.
True False
42. When a Note Receivable is paid, it becomes a Note Payable.
True False
43. A separate posting to the Cash account is made for each item in the Cash Book.
True False
44. An increase in salaries paid decreases proprietorship.
True False

45. Debits in the Journal are posted as credits to the Ledger. True False
46. An additional investment by the proprietor is debited to the Capital account. True False
47. The total of the Purchases Journal is posted to the credit of the Purchases account. True False
48. Payment of a household bill of the proprietor should be debited to the Drawing account. True False
49. All increases in Expenses are recorded in appropriate accounts as debits. True False
50. The information for the Profit and Loss Statement is obtained from the Balance Sheet columns in the Work Sheet. True False
51. A personal account in which the credit side of the account is larger than the debit side is considered a liability. True False
52. When the debits equal the credits a Trial Balance is said to be out of balance. True False
53. The person to whom merchandise is sold is called a creditor. True False
54. If all the notes given by the business are not paid, the Notes Payable account will show a debit balance. True False
55. If the Notes Payable account shows a credit balance, it indicates that not all the notes given or issued have been paid. True False
56. The balance of the Sales account is transferred to the credit side of the Profit and Loss Summary account. True False
57. Increases in assets are credited to the proper asset account. True False
58. In ruling the Capital account, the balance is brought down to the credit side of the account. True False

True False 88. In closing the Capital account, the balance is brought down to the credit side of the account.

True False 87. Increases in assets are credited to the proper asset account.

True False 86. The balance of the Sales account is transferred to the credit side of the Profit and Loss Summary account.

True False 85. If the Notes Payable account shows a credit balance, it indicates that not all the notes given or issued have been paid.

True False 84. If all the notes given by the business are not paid, the Notes Payable account will show a debit balance.

True False 83. The person to whom merchandise is sold is called a creditor.

True False 82. When the debits equal the credits a Trial Balance is said to be out of balance.

True False 81. A personal account in which the credit side of the account is larger than the debit side is considered a liability.

True False 80. The information for the Profit and Loss Statement is obtained from the Balance Sheet columns in the Work Sheet.

True False 79. All increases in Expenses are recorded in appropriate accounts as debits.

True False 78. Payment of a household bill of the proprietor should be debited to the Drawing account.

True False 77. The total of the Purchases Journal is posted to the credit of the Purchases account.

True False 76. An additional investment by the proprietor is debited to the Capital account.

True False 75. Debits in the Journal are posted as credits to the Ledger.

59. The balance of the Purchases account is transferred to the debit side of the Profit and Loss Summary account. True False

60. The difference between the supplies inventory and the supplies account appears in the Adjustment columns of the Work Sheet. True False

61. The debit side of Accounts Payable account usually exceed the credit side. True False

62. Only the assets, liabilities, and capital accounts appear in the Post-Closing Trial Balance. True False

63. The change in the asset account Supplies and Prepaid Insurance are recorded daily. True False

64. The balance of the Depreciation Reserve account subtracted from the asset account gives the book value of the asset. True False

65. Net profit is posted to the credit side of the Capital account. True False

66. The excess of the operating expenses of a business over the gross profit is net loss. True False

67. All cash sales are recorded in the Sales Journal. True False

68. The cash and capital accounts are balanced at the close of the fiscal period. True False

69. The account with each charge customer is credited with increases. True False

70. Gross Profit minus Operating Expense equals Net Profit. True False

71. When cash is the only investment, it is recorded in the General Journal. True False

72. Written promises to pay received from others are debited to the Notes Payable account. True False

73. Expired Insurance is the difference between Unexpired Insurance and the Prepaid Insurance. True False

59. The balance of the Purchases account is transferred to the debit side of the Profit and Loss Summary account.
True False
60. The difference between the supplies inventory and the supplies account appears in the adjustment column of the work sheet.
True False
61. The debit side of accounts payable account usually exceeds the credit side.
True False
62. Only the assets, liabilities, and unearned accounts appear in the Post-Closing Trial Balance.
True False
63. The change in the asset account Supplies and Prepaid Insurance are recorded daily.
True False
64. The balance of the Depreciation Reserve account subtracted from the asset account gives the book value of the asset.
True False
65. Net profit is posted to the credit side of the Capital account.
True False
66. The excess of the operating expenses of a business over the gross profit is net loss.
True False
67. All cash sales are recorded in the Sales Journal.
True False
68. The cash and capital accounts are balanced at the close of the fiscal period.
True False
69. The account with each charge customer is credited with interest.
True False
70. Gross Profit minus Operating Expenses equals Net Profit.
True False
71. When cash is the only investment, it is recorded in the General Journal.
True False
72. When promises to pay received from others are debited to the Notes Payable account.
True False
73. Expired Insurance is the difference between Unexpired Insurance and the Prepaid Insurance.
True False

74. Adjusting entries are made at the beginning of a fiscal period. True False

75. The amount of each sale in the Sales Journal is posted to the debit of the customer's account in the Ledger. True False

76. Error in posting to the wrong account is not revealed by the Trial Balance. True False

77. Expired Insurance appears in the Balance Sheet Statement. True False

78. The cost of supplies used is entered in the Balance Sheet columns of the Work Sheet. True False

79. Supplies become an expense when a part or all of the supplies are used. True False

80. Depreciation Reserve account usually has a credit balance. True False

81. The amount of insurance expired is entered in the Profit and Loss columns of the Work Sheet. True False

82. Prepaid Insurance account is an expense account. True False

83. The cost of goods sold during a period is always the difference between sales of that period and purchases. True False

84. The statement of assets, liabilities, and proprietorship is called a Profit and Loss Statement. True False

85. Accounts with creditors are classified as Accounts Receivable. True False

86. At the close of the fiscal period, the ending Merchandise Inventory is debited to the Purchases account. True False

87. Return purchases are recorded as credits to the Purchases account. True False

74. Adjusting entries are made at the beginning of a fiscal period.
True False
75. The amount of each sale in the Sales Journal is posted to the debit of the customer's account in the ledger.
True False
76. Error in posting to the wrong account is not revealed by the Trial Balance.
True False
77. Expired Insurance appears in the Balance Sheet Statement.
True False
78. The cost of supplies used is entered in the Balance Sheet column of the Work Sheet.
True False
79. Supplies become an expense when a part or all of the supplies are used.
True False
80. Prepaid Insurance Reserve account usually has a credit balance.
True False
81. The amount of insurance expired is entered in the Profit and Loss column of the Work Sheet.
True False
82. Prepaid Insurance account is an expense account.
True False
83. The cost of goods sold during a period is always the difference between sales of that period and purchases.
True False
84. The statement of assets, liabilities, and proprietorship is called a Profit and Loss Statement.
True False
85. Accounts with creditors are classified as Accounts Receivable.
True False
86. At the close of the fiscal period, the ending Merchandise Inventory is debited to the Purchases account.
True False
87. Return purchases are recorded as credits to the Purchases account.
True False

88. At the close of a fiscal period all income and expense accounts are closed into the Profit and Loss Summary account. True False

89. All asset accounts in the ledger are adjusted at the close of the fiscal period. True False

90. The amount of fuel used during a period would appear in the Balance Sheet as a liability. True False

91. There is no particular order as to the arrangement of accounts in the ledger. True False

92. The total of all debits as recorded in the ledger accounts should equal the total of all the credits. True False

93. The beginning Merchandise Inventory is debited to the Purchases account at the close of the fiscal period. True False

94. The balance of the Cash account in the ledger is brought down to the credit side of the account. True False

95. Depreciation Expense account is closed into the credit side of the Profit and Loss Summary account. True False

96. In closing the ledger, if the credits in the Profit and Loss Summary account exceed the debits, the difference is a loss. True False

97. Depreciation Reserve account appears in the Profit and Loss Statement. True False

98. The use of several books or journals of original entry reduces the number of postings to be made. True False

99. The Cash Book is proved after posting to the Ledger. True False

100. A note received in payment on account is entered in the General Journal. True False

88. At the close of a fiscal period all income and expense accounts are closed into the Profit and Loss Summary account.
True False

89. All asset accounts in the ledger are adjusted at the close of the fiscal period.
True False

90. The amount of fuel used during a period would appear in the Balance Sheet as a liability.
True False

91. There is no particular order as to the arrangement of accounts in the ledger.
True False

92. The total of all debits as recorded in the ledger accounts should equal the total of all the credits.
True False

93. The beginning Merchandise Inventory is debited to the Purchase account at the close of the fiscal period.
True False

94. The balance of the Cash account in the ledger is brought down to the credit side of the account.
True False

95. Depreciation Expense account is closed into the credit side of the Profit and Loss Summary account.
True False

96. In closing the ledger, if the credits in the Profit and Loss Summary account exceed the debits, the difference is a loss.
True False

97. Corporation Reserve account appears in the Profit and Loss Statement.
True False

98. The use of several books or journals of original entry reduces the number of postings to be made.
True False

99. The Cash Book is proved after posting to the ledger.
True False

100. A note received in payment on account is entered in the General Journal.
True False

TABLE VI
GROUP A

Score Table with Intelligence Quotient

<u>Case</u>	<u>I.Q.</u>	<u>Score</u> <u>1-99</u> <u>Oral</u>	<u>Reading</u> <u>2-100</u> <u>Score</u>
1	103	88	88
2	94	80	80
3	100	78	72
4	108	78	72
5	105	96	84
6	109	76	76
7	95	78	72
8	102	74	82
9	101	72	70
10	108	80	84
11	119	82	82
12	101	88	92
13	103	86	94
14	110	92	88
15	98	82	94
16	107	76	76
17	110	86	82
18	106	82	90
19	115	82	78
20	84	60	74
21	105	70	86
22	111	74	84
23	98	90	88
24	105	76	76
25	104	68	78
26	104	72	78
27	92	62	66
28	102	70	78
29	110	72	68
30	102	84	90
31	98	64	70
32	95	66	74
33	110	72	70
34	100	80	72
35	94	68	76
36	98	78	70
37	107	78	82
38	107	86	86

TABLE VI
GROUP A

Score Table with Intelligence Quotient

Case	I. Q.	Score 1-99 Oral	Reading 8-100 Score
1	103	98	98
2	94	90	90
3	100	73	72
4	103	78	72
5	105	96	94
6	109	78	78
7	98	92	72
8	102	74	92
9	101	72	70
10	109	90	84
11	119	92	82
12	101	88	92
13	103	86	94
14	110	92	98
15	98	92	94
16	107	78	78
17	110	92	92
18	100	82	90
19	118	82	78
20	84	60	74
21	103	70	82
22	111	74	84
23	98	90	88
24	103	78	78
25	104	82	78
26	104	72	72
27	92	82	82
28	102	70	78
29	110	78	88
30	102	84	90
31	99	84	70
32	92	88	74
33	110	72	70
34	100	80	72
35	94	68	70
36	99	70	70
37	107	78	92
38	107	88	82

TABLE VII
PART 2

Table with Intelligence Quotient

39	95	70	72
40	108	76	90
41	113	78	86
42	114	84	92
43	104	70	74
44	93	66	68
45	106	84	86
46	96	64	78
47	95	78	84
48	88	80	80
49	97	80	70
50	108	74	88
51	98	84	74
52	99	78	80
53	118	76	82
54	105	80	94
55	95	78	78
56	91	78	80
57	96	88	72
58	96	80	84
59	98	74	88
60	104	76	80
61	104	74	76
62	98	80	94
63	102	88	82
64	118	84	88
65	81	84	88
66	108	84	90
67	100	82	80
68	106	84	82
69	95	78	80
70	108	82	86
71	98	84	83
72	90	86	83
73	108	78	100
74	108	80	84
75	104	84	86
76	97	86	88
77	111	86	86
78	89	88	78
79	112	88	90
80	101	84	80
81	96	88	70
82	105	88	78

35	70	80	30
30	75	80	40
30	78	81	41
30	80	81	42
44	70	80	42
30	80	80	44
30	84	80	42
30	84	80	42
48		80	48

TABLE VII
GROUP B

Score Table with Intelligence Quotient

<u>Case</u>	<u>I.Q.</u>	<u>Score 1-99 Oral</u>	<u>Score 2-100 Reading</u>
1	96	74	76
2	99	74	76
3	98	78	84
4	96	86	80
5	99	80	70
6	108	74	82
7	96	64	74
8	99	78	68
9	115	76	82
10	105	86	94
11	95	76	78
12	91	72	80
13	96	68	72
14	96	80	84
15	90	74	68
16	104	76	80
17	104	74	76
18	92	82	94
19	102	88	82
20	113	86	82
21	81	64	68
22	108	84	90
23	100	82	80
24	106	84	92
25	95	78	80
26	105	82	88
27	96	84	88
28	90	86	62
29	102	78	100
30	105	80	84
31	104	94	98
32	97	86	88
33	111	86	88
34	89	82	78
35	112	88	90
36	101	84	80
37	98	68	70
38	105	68	72

TABLE VII
GROUP B

Score Tests with Intelligence Quotient

Score 1-100 Reading	Score 1-100 Cv	I. Q.	Class
78	74	98	1
75	74	98	2
84	78	98	3
80	88	98	4
70	80	98	5
82	74	108	6
74	84	98	7
88	78	98	8
88	78	112	9
84	88	102	10
78	78	98	11
80	78	91	12
72	68	98	13
84	80	98	14
68	74	90	15
80	78	104	16
78	74	104	17
84	88	98	18
82	88	108	19
82	88	112	20
88	84	81	21
80	84	108	22
80	82	100	23
88	84	108	24
80	78	98	25
88	88	108	26
88	84	98	27
82	88	90	28
100	78	108	29
84	80	108	30
88	84	104	31
88	88	97	32
88	88	111	33
78	88	98	34
80	88	112	35
80	84	101	36
70	88	98	37
72	88	102	38

39	94	82	92
40	105	68	72
41	83	76	74
42	115	90	94
43	104	72	58
44	100	80	72
45	119	86	94
46	99	78	76

A plus B	(1-78 oral)	78.07	8.55
	(8-100 oral)		
A plus B	(1-78 reading)	80.07	8.48
	(8-100 reading)		

30	83	84	20
72	88	102	40
74	76	82	41
84	90	112	42
26	72	104	43
72	80	100	44
84	82	112	45
76	78	86	46

TABLE VIII

TEST SCORE MEANS and STANDARD DEVIATIONS

<u>Group</u>	<u>Test</u>	<u>Mean</u>	<u>Standard Deviation</u>
A	1-99 oral	77.63	8.35
"	2-100 reading	80.35	7.80
B	1-99 oral	81.	9.01
"	2-100 reading	79.7	7.20
A plus B	(1-99 oral (2-100 oral	78.67	8.85
A plus B	(1-99 reading (2-100 reading	80.67	8.45

TABLE VIII
TEST SCORE MEANS AND STANDARD DEVIATIONS

Group	Test	Mean	Standard Deviation
A	1-99 oral	77.83	8.35
"	2-100 reading	80.33	7.80
B	1-99 oral	81.	9.01
"	2-100 reading	79.7	7.20
A plus B	(1-99 oral) (2-100 oral)	78.87	8.85
A plus B	(1-99 reading) (2-100 reading)	80.87	8.45

TABLE IX
INTELLIGENCE QUOTIENT MEANS and STANDARD DEVIATIONS

<u>Group</u>	<u>Mean</u>	<u>Standard Deviation</u>
A	103.81	7.75
B	101.09	8.05
A plus B	102.44	7.75

TABLE IX
INTELLIGENCE QUOTIENT MEANS AND STANDARD DEVIATIONS

<u>Group</u>	<u>Mean</u>	<u>Standard Deviation</u>
A	102.81	7.75
B	101.09	8.08
A plus B	102.45	7.78

STATISTICAL RESEARCH

CORRELATION SCATTERGRAMS

STATE WIND RESERVE

CONSERVATION OF SCOTT FOREMAN

DIAGRAM I
Correlation of Group A-Intelligence Quotient
with Oral Test-Questions 1-99; $r = .49$

	Intelligence Quotient								F_x	\bar{I}_x	$F\bar{I}_x$	$F\bar{I}_x^2$	$\sum x'y'$
	80 84	85 89	90 94	95 99	100 104	105 109	110 114	115 119					
100 96						1			1	4	4	16	+ -
95 91							1		1	3	3	9	6
90 86				1	3	1	1		6	2	12	24	6 2
85 81				1	1	2	1	2	7	1	7(26)	7	10 1
80 76			1	2	2	7	1		13	0			
75 71					3		3		6	-1	6	6	6
70 66			2	2	3	1			8	-2	16	32	12 2
65 61	1		1	2					4	-3	12(-34)	36	24
F_y	1	0	4	8	12	12	7	2	46	-8	130		62 11 (51)

$$\bar{I}_y = -4 \quad -3 \quad -2 \quad -1 \quad 0 \quad 1 \quad 2 \quad 3$$

$$F\bar{I}_y = 4 \quad 0 \quad -8 \quad -8(-20) \quad 12 \quad 14 \quad 6(32) = 12$$

$$F\bar{I}_y^2 = 16 \quad 16 \quad 8 \quad 12 \quad 28 \quad 18 = 98$$

$$c_y = \frac{12}{46} = .261$$

$$c_y^2 = .068$$

$$C_y = 1.305$$

$$M_y = 103.81$$

$$\sigma_y = \sqrt{\frac{98}{46} - .068 \times 5}$$

$$= 1.43 \times 5$$

$$= 7.15$$

$$c_x = \frac{-8}{46} = -.174$$

$$c_x^2 = .03$$

$$C_x = .87$$

$$M_x = 77.63$$

$$\sigma_x = \sqrt{\frac{130}{46} - .03 \times 5}$$

$$= 1.67 \times 5$$

$$= 8.35$$

$$r = \frac{\frac{\sum xy}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{51}{46} - (.261 \times -.174)}{1.43 \times 1.67}$$

$$= .491$$

$$P.E. = .07$$

TABLE I
 Correlation of Group A-Intelligence Quotient
 with Oral Test-Questions 1-25; r = .49
 Intelligence Quotient

	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	370	372	374	376	378	380	382	384	386	388	390	392	394	396	398	400	402	404	406	408	410	412	414	416	418	420	422	424	426	428	430	432	434	436	438	440	442	444	446	448	450	452	454	456	458	460	462	464	466	468	470	472	474	476	478	480	482	484	486	488	490	492	494	496	498	500	502	504	506	508	510	512	514	516	518	520	522	524	526	528	530	532	534	536	538	540	542	544	546	548	550	552	554	556	558	560	562	564	566	568	570	572	574	576	578	580	582	584	586	588	590	592	594	596	598	600	602	604	606	608	610	612	614	616	618	620	622	624	626	628	630	632	634	636	638	640	642	644	646	648	650	652	654	656	658	660	662	664	666	668	670	672	674	676	678	680	682	684	686	688	690	692	694	696	698	700	702	704	706	708	710	712	714	716	718	720	722	724	726	728	730	732	734	736	738	740	742	744	746	748	750	752	754	756	758	760	762	764	766	768	770	772	774	776	778	780	782	784	786	788	790	792	794	796	798	800	802	804	806	808	810	812	814	816	818	820	822	824	826	828	830	832	834	836	838	840	842	844	846	848	850	852	854	856	858	860	862	864	866	868	870	872	874	876	878	880	882	884	886	888	890	892	894	896	898	900	902	904	906	908	910	912	914	916	918	920	922	924	926	928	930	932	934	936	938	940	942	944	946	948	950	952	954	956	958	960	962	964	966	968	970	972	974	976	978	980	982	984	986	988	990	992	994	996	998	1000	1002	1004	1006	1008	1010	1012	1014	1016	1018	1020	1022	1024	1026	1028	1030	1032	1034	1036	1038	1040	1042	1044	1046	1048	1050	1052	1054	1056	1058	1060	1062	1064	1066	1068	1070	1072	1074	1076	1078	1080	1082	1084	1086	1088	1090	1092	1094	1096	1098	1100	1102	1104	1106	1108	1110	1112	1114	1116	1118	1120	1122	1124	1126	1128	1130	1132	1134	1136	1138	1140	1142	1144	1146	1148	1150	1152	1154	1156	1158	1160	1162	1164	1166	1168	1170	1172	1174	1176	1178	1180	1182	1184	1186	1188	1190	1192	1194	1196	1198	1200	1202	1204	1206	1208	1210	1212	1214	1216	1218	1220	1222	1224	1226	1228	1230	1232	1234	1236	1238	1240	1242	1244	1246	1248	1250	1252	1254	1256	1258	1260	1262	1264	1266	1268	1270	1272	1274	1276	1278	1280	1282	1284	1286	1288	1290	1292	1294	1296	1298	1300	1302	1304	1306	1308	1310	1312	1314	1316	1318	1320	1322	1324	1326	1328	1330	1332	1334	1336	1338	1340	1342	1344	1346	1348	1350	1352	1354	1356	1358	1360	1362	1364	1366	1368	1370	1372	1374	1376	1378	1380	1382	1384	1386	1388	1390	1392	1394	1396	1398	1400	1402	1404	1406	1408	1410	1412	1414	1416	1418	1420	1422	1424	1426	1428	1430	1432	1434	1436	1438	1440	1442	1444	1446	1448	1450	1452	1454	1456	1458	1460	1462	1464	1466	1468	1470	1472	1474	1476	1478	1480	1482	1484	1486	1488	1490	1492	1494	1496	1498	1500	1502	1504	1506	1508	1510	1512	1514	1516	1518	1520	1522	1524	1526	1528	1530	1532	1534	1536	1538	1540	1542	1544	1546	1548	1550	1552	1554	1556	1558	1560	1562	1564	1566	1568	1570	1572	1574	1576	1578	1580	1582	1584	1586	1588	1590	1592	1594	1596	1598	1600	1602	1604	1606	1608	1610	1612	1614	1616	1618	1620	1622	1624	1626	1628	1630	1632	1634	1636	1638	1640	1642	1644	1646	1648	1650	1652	1654	1656	1658	1660	1662	1664	1666	1668	1670	1672	1674	1676	1678	1680	1682	1684	1686	1688	1690	1692	1694	1696	1698	1700	1702	1704	1706	1708	1710	1712	1714	1716	1718	1720	1722	1724	1726	1728	1730	1732	1734	1736	1738	1740	1742	1744	1746	1748	1750	1752	1754	1756	1758	1760	1762	1764	1766	1768	1770	1772	1774	1776	1778	1780	1782	1784	1786	1788	1790	1792	1794	1796	1798	1800	1802	1804	1806	1808	1810	1812	1814	1816	1818	1820	1822	1824	1826	1828	1830	1832	1834	1836	1838	1840	1842	1844	1846	1848	1850	1852	1854	1856	1858	1860	1862	1864	1866	1868	1870	1872	1874	1876	1878	1880	1882	1884	1886	1888	1890	1892	1894	1896	1898	1900	1902	1904	1906	1908	1910	1912	1914	1916	1918	1920	1922	1924	1926	1928	1930	1932	1934	1936	1938	1940	1942	1944	1946	1948	1950	1952	1954	1956	1958	1960	1962	1964	1966	1968	1970	1972	1974	1976	1978	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050	2052	2054	2056	2058	2060	2062	2064	2066	2068	2070	2072	2074	2076	2078	2080	2082	2084	2086	2088	2090	2092	2094	2096	2098	2100	2102	2104	2106	2108	2110	2112	2114	2116	2118	2120	2122	2124	2126	2128	2130	2132	2134	2136	2138	2140	2142	2144	2146	2148	2150	2152	2154	2156	2158	2160	2162	2164	2166	2168	2170	2172	2174	2176	2178	2180	2182	2184	2186	2188	2190	2192	2194	2196	2198	2200	2202	2204	2206	2208	2210	2212	2214	2216	2218	2220	2222	2224	2226	2228	2230	2232	2234	2236	2238	2240	2242	2244	2246	2248	2250	2252	2254	2256	2258	2260	2262	2264	2266	2268	2270	2272	2274	2276	2278	2280	2282	2284	2286	2288	2290	2292	2294	2296	2298	2300	2302	2304	2306	2308	2310	2312	2314	2316	2318	2320	2322	2324	2326	2328	2330	2332	2334	2336	2338	2340	2342	2344	2346	2348	2350	2352	2354	2356	2358	2360	2362	2364	2366	2368	2370	2372	2374	2376	2378	2380	2382	2384	2386	2388	2390	2392	2394	2396	2398	2400	2402	2404	2406	2408	2410	2412	2414	2416	2418	2420	2422	2424	2426	2428	2430	2432	2434	2436	2438	2440	2442	2444	2446	2448	2450	2452	2454	2456	2458	2460	2462	2464	2466	2468	2470	2472	2474	2476	2478	2480	2482	2484	2486	2488	2490	2492	2494	2496	2498	2500	2502	2504	2506	2508	2510	2512	2514	2516	2518	2520	2522	2524	2526	2528	2530	2532	2534	2536	2538	2540	2542	2544	2546	2548	2550	2552	2554	2556	2558	2560	2562	2564	2566	2568	2570	2572	2574	2576	2578	2580	2582	2584	2586	2588	2590	2592	2594	2596	2598	2600	2602	2604	2606	2608	2610	2612	2614	2616	2618	2620	2622	2624	2626	2628	2630	2632	2634	2636	2638	2640	2642	2644	2646	2648	2650	2652	2654	2656	2658	2660	2662	2664	2666	2668	2670	2672	2674	2676	2678	2680	2682	2684	2686	2688	2690	2692	2694	2696	2698	2700	2702	2704	2706	2708	2710	2712	2714	2716	2718	2720	2722	2724	2726	2728	2730	2732	2734	2736	2738	2740	2742	2744	2746	2748	2750	2752	2754	2756	2758	2760	2762	2764	2766	2768	2770	2772	2774	2776	2778	2780	2782	2784	2786	2788	2790	2792	2794	2796	2798	2800	2802	2804	2806	2808	2810	2812	2814	2816	2818	2820	2822	2824	2826	2828	2830	2832	2834	2836	2838	2840	2842	2844	2846	2848	2850	2852	2854	2856	2858	2860	2862	2864	2866	2868	2870	2872	2874	2876	2878	2880	2882	2884	2886	2888	2890	2892	2894	2896	2898	2900	2902	2904	2906	2908	
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DIAGRAM II

Correlation of Group A-Intelligence Quotient
with Reading Test-Questions 2-100; $r=.38$
Intelligence Quotient

Intelligence Quotient									F_x	D_x	$F D_x$	$F D_x^2$	$\Sigma x'y'$
	80	85	90	95	100	105	110	115					
	84	89	94	99	104	109	114	119					
100													+
96													-
95													
91				1	2		1		4	3	12	36	6 3
90													
86				1	2	5	2		10	2	20	40	18 2
85													
81					1	3	2	1	7	1	7(39)	7	10
80													
76				2	1	3	3	1	10	0			
75													
71	1			3	3	1			8	-1	8	8	7 1
70													
66			2	2	1		2		7	-2	14(-22)	28	12 8
65													
61									0				

$$C_X = \frac{17}{46} = .369$$

$$C^2_X = .137$$

$$C_x = 1.85$$

$$M_x = 80.35$$

$$\sigma_x = \sqrt{\frac{119}{46} - .137} \times 10^{-5}$$

$$= 1.56 \times 5$$

$$= 7.8$$

$$r = \frac{\frac{\sum x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{39}{46} - (.261 \times .369)}{1.43 \times 1.56}$$

= .38

P.E. = .08

$$c_y = \frac{12}{46} = .261$$

$$\sigma_y = \sqrt{\frac{98}{46}} = .068 \times 5 =$$

$$C^2_y = .068$$

$$= 1.43 \times 5$$

2 7.15

$\epsilon_g = 1.305$

$$M_y = 103.81$$

DIAGRAM III
Correlation of Group B-Intelligence Quotient
with Oral Test-Questions 2-100; $r = .34$

	Intelligence Quotient								F_x	$\sum x$	$F\sum x$	$F\sum x^2$	$\sum x'y'$
	80 84	85 89	90 94	95 99	100 104	105 109	110 114	115 119					
100													
96													
95					1				1	3	3	9	3
91													
90			1	2	1	1	3	2	10	2	20	40	40 2
86													
85		1	2	1	2	3			9	1	9 (32)	9	8 4
81													
80				7	3	1		1	13	0			
76	1												
75			2	2	2	1			7	-1	7	7	2 4
71													
70				2		2			4	-2	8	16	8
66													
65				1					2	-3	6 (-21)	18	9
61	1												
F_y	2	1	5	15	9	8	3	3	46	11	99	99	62 -18
$\sum y$	-3	-2	-1	0	1	2	3	4					(44)
$F\sum y$	6	2	5	(-13)	9	16	9	12	(46) = 33				
$F\sum y^2$	18	4	5		9	32	27	48	= 143				

$$c_y = \frac{33}{46} = .717$$

$$C_y = .717 \times 5 = 3.585$$

$$c^2_y = .514$$

$$M_y = 101.09$$

$$\sigma_y = \sqrt{\frac{143}{46} - .514 \times 5}$$

$$= 1.61 \times 5$$

$$= 8.05$$

$$c_x = \frac{11}{46} = .239$$

$$c^2_x = .057$$

$$C_x = 1.195$$

$$M_x = 79.7$$

$$\sigma_x = \sqrt{\frac{99}{46} - .057 \times 5}$$

$$= 1.44 \times 5$$

$$= 7.2$$

$$r = \frac{\frac{\sum x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{44}{46} - (.717 \times .239)}{1.61 \times 1.44}$$

$$= .34$$

$$P.E. = .09$$

DIAGRAM IV

Correlation of Group B-Intelligence Quotient
with Reading Test--Questions 1-99; $r = .45$

Reading Test--1-99	Intelligence Quotient								F_x	\bar{I}_x	$F\bar{I}_x$	$F\bar{I}_x^2$	$\Sigma x'y'$
	80	85	90	95	100	105	110	115					
	84	89	94	99	104	109	114	119					
100					2				2	4	8	32	8
96													
95													
91			2			2		2	6	3	18	54	36 6
90													
86				2		2	2		6	2	12	24	20
85													
81				2	1	2	1	1	7	1	7(25)	7	12
80													
76		1	1	6	4				12	0			
75													
71	1			2	1	2			6	-1	6	6	3 5
70													
66	1		1	3					5	-2	10	20	8
65													
61			1		1				2	-3	6(-22)	18	3 3
F_y	2	1	5	15	9	8	3	3	46		23	161	90 14
\bar{I}_y	-3	-2	-1	0	1	2	3	4					(76)
$F\bar{I}_y$	6	2	5(-13)	9	16	9	12(46)						
$F\bar{I}_y^2$	18	4	5		9	32	27	48					

$$c_y = \frac{33}{46} = .717$$

$$c_y = .3585$$

$$c_y^2 = .514$$

$$M_y = 101.09$$

$$\sigma_y = \sqrt{\frac{143}{46} - .514 \times .5}$$

$$= 1.61 \times .5$$

$$= 8.05$$

$$c_x = \frac{23}{46} = .5$$

$$c_x^2 = .25$$

$$M_x = 81$$

$$\sigma_x = \sqrt{\frac{161}{46} - .25 \times .5}$$

$$= 1.802 \times .5$$

$$= 9.01$$

$$r = \frac{\frac{\Sigma x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{76}{46} - (.5 \times .717)}{1.61 \times 1.80}$$

$$= .45$$

$$P.E. = .08$$

DIAGRAM V
Correlation of Group A-Oral Test-1-99
with Reading Test-Questions 2-100 $r = .64$
Reading Test-Questions 2-100

	61	66	71	76	81	86	91	96	F_x	D_x	$F D_x$	$F D_x^2$	$\sum x'y'$
	65	70	75	80	85	90	95	100					
100					1				1	4	4	16	4
96						1			1	3	3	9	6
95							1		6	2	12	24	26
91					1	3	2		7	1	7(26)	7	13
90													
86					1	3	2		7	1	7(26)	7	13
85				1	1	3	2		7	1	7(26)	7	13
81													
80				1	1	3	2		7	1	7(26)	7	13
76		1	4	4	2	2			13	0			
75													
71		3		1	2				6	-1	6	6	6 2
70													
66		1	3	3		1			8	-2	16	32	10 4
65													
61		2	1	1					4	-3	12(34)	36	15

F_y	0	7	8	10	7	10	4	0	46				
D_y		-2	-1	0	1	2	3	4					
$F D_y$		14	8	(-22)	7	20	12	(39) = 17					
$F D_y^2$		28	8		7	40	36	= 119					

$$c_y = \frac{17}{46} = .369 \quad \sigma_y = \sqrt{\frac{119}{46} - .136 \times 5}$$

$$c_y^2 = .136$$

$$= 1.56 \times 5$$

$$C_y = 1.85$$

$$= 7.8$$

$$M_y = 80.35$$

$$c_x = \frac{-8}{46} = -.173$$

$$c_x^2 = .03$$

$$C_x = -.865$$

$$M_x = 77.14$$

$$\sigma_x = \sqrt{\frac{130}{46} - .03 \times 5}$$

$$= 1.67 \times 5$$

$$= 8.35$$

$$r = \frac{\frac{\sum x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{74}{46} - (-.173 \times .369)}{1.67 \times 1.56}$$

$$= .64$$

$$P.E. = .06$$

DIAGRAM VI
Correlation of Group B-Oral Test-2-100
with Reading Test-Questions 1-99 r-.61
Reading Test-Questions 1-99

Reading Test-Questions 1-99

	61 65	66 70	71 75	76 80	81 85	86 90	91 95	96 100	F_x	\bar{J}_x	$F\bar{J}_x$	$F\bar{J}_x^2$	$\sum x'y$
100													
96													
95								1	1	3	3	9	12
91													
90													
86	1			1	2	3	3		10	2	20	40	34 6
85													
81				3		3	3		9	1	9 (32)	9	15
80													
76		2	2	4	4			1	13	0			
75													
71	1	1		4	1				7	-1	7	7	5 1
70													
66		1	3						4	-2	8	16	10
65													
61		1	1						2	-3	6 (-21)	18	9

Oral Test-Questions 2-100

$$C_X = \frac{11}{46} = .239$$

$$\chi^2 = .057$$

Cx^2 p. 2

$$M_x = 79.7$$

$$\sigma_x = \sqrt{\frac{99}{46} - .057} \times 10^{-}$$

$$= 1.44 \times 5$$

= 7.2

$$r = \frac{\frac{\sum xy'}{N} - c_x c_y}{\sqrt{\frac{\sum x^2}{N} - c_x^2} \sqrt{\frac{\sum y^2}{N} - c_y^2}}$$

$$= \frac{\frac{78}{46} - (.239 \times .5)}{1.44 \times 1.80}$$

61

P. E. = .06

Correlation of Group B-Test-24100
with Reading Test-Questions 1-32
Reading Test-Questions 1-32

OUT-2 QUESTIONS-Test-24100		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1																																	
2																																	
3																																	
4																																	
5																																	
6																																	
7																																	
8																																	
9																																	
10																																	
11																																	
12																																	
13																																	
14																																	
15																																	
16																																	
17																																	
18																																	
19																																	
20																																	
21																																	
22																																	
23																																	
24																																	
25																																	
26																																	
27																																	
28																																	
29																																	
30																																	
31																																	
32																																	

$\frac{1}{2} = 0.5$
 $\frac{1}{4} = 0.25$
 $\frac{1}{8} = 0.125$
 $\frac{1}{16} = 0.0625$
 $\frac{1}{32} = 0.03125$
 $\frac{1}{64} = 0.015625$
 $\frac{1}{128} = 0.0078125$
 $\frac{1}{256} = 0.00390625$
 $\frac{1}{512} = 0.001953125$
 $\frac{1}{1024} = 0.0009765625$
 $\frac{1}{2048} = 0.00048828125$
 $\frac{1}{4096} = 0.000244140625$
 $\frac{1}{8192} = 0.0001220703125$
 $\frac{1}{16384} = 0.00006103515625$
 $\frac{1}{32768} = 0.000030517578125$
 $\frac{1}{65536} = 0.0000152587890625$
 $\frac{1}{131072} = 0.00000762939453125$
 $\frac{1}{262144} = 0.000003814697265625$
 $\frac{1}{524288} = 0.0000019073486328125$
 $\frac{1}{1048576} = 0.00000095367431640625$
 $\frac{1}{2097152} = 0.000000476837158203125$
 $\frac{1}{4194304} = 0.0000002384185791015625$
 $\frac{1}{8388608} = 0.00000011920928955078125$
 $\frac{1}{16777216} = 5.9604644775390625 \times 10^{-8}$
 $\frac{1}{33554432} = 2.9802322387695312 \times 10^{-8}$
 $\frac{1}{67108864} = 1.4901161193847656 \times 10^{-8}$
 $\frac{1}{134217728} = 7.450580596923828 \times 10^{-9}$
 $\frac{1}{268435456} = 3.725290298461914 \times 10^{-9}$
 $\frac{1}{536870912} = 1.862645149230957 \times 10^{-9}$
 $\frac{1}{1073741824} = 9.313225746154785 \times 10^{-10}$
 $\frac{1}{2147483648} = 4.656612873077392 \times 10^{-10}$
 $\frac{1}{4294967296} = 2.328306436538696 \times 10^{-10}$
 $\frac{1}{8589934592} = 1.164153218269348 \times 10^{-10}$
 $\frac{1}{17179869184} = 5.82076609134674 \times 10^{-11}$
 $\frac{1}{34359738368} = 2.91038304567337 \times 10^{-11}$
 $\frac{1}{68719476736} = 1.455191522836685 \times 10^{-11}$
 $\frac{1}{137438953472} = 7.275957614183425 \times 10^{-12}$
 $\frac{1}{274877906944} = 3.637978807091712 \times 10^{-12}$
 $\frac{1}{549755813888} = 1.818989403545856 \times 10^{-12}$
 $\frac{1}{1099511627776} = 9.09494701772928 \times 10^{-13}$
 $\frac{1}{2199023255552} = 4.54747350886464 \times 10^{-13}$
 $\frac{1}{4398046511104} = 2.27373675443232 \times 10^{-13}$
 $\frac{1}{8796093022208} = 1.13686837721616 \times 10^{-13}$
 $\frac{1}{17592186044416} = 5.6843418860808 \times 10^{-14}$
 $\frac{1}{35184372088832} = 2.8421709430404 \times 10^{-14}$
 $\frac{1}{70368744177664} = 1.4210854715202 \times 10^{-14}$
 $\frac{1}{140737488355328} = 7.105427357601 \times 10^{-15}$
 $\frac{1}{281474976710656} = 3.5527136788005 \times 10^{-15}$
 $\frac{1}{562949953421312} = 1.77635683940025 \times 10^{-15}$
 $\frac{1}{1125899906842624} = 8.88178419700125 \times 10^{-16}$
 $\frac{1}{2251799813685248} = 4.440892098500625 \times 10^{-16}$
 $\frac{1}{4503599627370496} = 2.2204460492503125 \times 10^{-16}$
 $\frac{1}{9007199254740992} = 1.1102230246251562 \times 10^{-16}$
 $\frac{1}{18014398509481984} = 5.551115123125781 \times 10^{-17}$
 $\frac{1}{36028797018963968} = 2.7755575615628905 \times 10^{-17}$
 $\frac{1}{72057594037927936} = 1.3877787807814452 \times 10^{-17}$
 $\frac{1}{144115188075855872} = 6.938893903907226 \times 10^{-18}$
 $\frac{1}{288230376151711744} = 3.469446951953613 \times 10^{-18}$
 $\frac{1}{576460752303423488} = 1.7347234759768065 \times 10^{-18}$
 $\frac{1}{1152921504606846976} = 8.673617379884032 \times 10^{-19}$
 $\frac{1}{2305843009213693952} = 4.336808689942016 \times 10^{-19}$
 $\frac{1}{4611686018427387904} = 2.168404344971008 \times 10^{-19}$
 $\frac{1}{9223372036854775808} = 1.084202172485504 \times 10^{-19}$
 $\frac{1}{18446744073709551616} = 5.42101086242752 \times 10^{-20}$
 $\frac{1}{36893488147419103232} = 2.71050543121376 \times 10^{-20}$
 $\frac{1}{73786976294838206464} = 1.35525271560688 \times 10^{-20}$
 $\frac{1}{147573952589676412928} = 6.7762635780344 \times 10^{-21}$
 $\frac{1}{295147905179352825856} = 3.3881317890172 \times 10^{-21}$
 $\frac{1}{590295810358705651712} = 1.6940658945086 \times 10^{-21}$
 $\frac{1}{1180591620717411303424} = 8.470329472543 \times 10^{-22}$
 $\frac{1}{2361183241434822606848} = 4.2351647362715 \times 10^{-22}$
 $\frac{1}{4722366482869645213696} = 2.11758236813575 \times 10^{-22}$
 $\frac{1}{9444732965739290427392} = 1.058791184067875 \times 10^{-22}$
 $\frac{1}{18889465931478580854784} = 5.293955920339375 \times 10^{-23}$
 $\frac{1}{37778931862957161709568} = 2.6469779601696875 \times 10^{-23}$
 $\frac{1}{75557863725914323419136} = 1.3234889800848437 \times 10^{-23}$
 $\frac{1}{151115727451828646838272} = 6.617444900424218 \times 10^{-24}$
 $\frac{1}{302231454903657293676544} = 3.308722450212109 \times 10^{-24}$
 $\frac{1}{604462909807314587353088} = 1.6543612251060545 \times 10^{-24}$
 $\frac{1}{1208925819614629174706176} = 8.271806125530272 \times 10^{-25}$
 $\frac{1}{2417851639229258349412352} = 4.135903062765136 \times 10^{-25}$
 $\frac{1}{4835703278458516698824704} = 2.067951531382568 \times 10^{-25}$
 $\frac{1}{9671406556917033397649408} = 1.033975765691284 \times 10^{-25}$
 $\frac{1}{19342813113834066795298816} = 5.16987882845642 \times 10^{-26}$
 $\frac{1}{38685626227668133590597632} = 2.58493941422821 \times 10^{-26}$
 $\frac{1}{77371252455336267181195264} = 1.292469707114105 \times 10^{-26}$
 $\frac{1}{154742504910672534362390528} = 6.462348535570525 \times 10^{-27}$
 $\frac{1}{309485009821345068724781056} = 3.2311742677852625 \times 10^{-27}$
 $\frac{1}{618970019642690137449562112} = 1.6155871338926312 \times 10^{-27}$
 $\frac{1}{1237940039285380274899124224} = 8.077935669463156 \times 10^{-28}$
 $\frac{1}{2475880078570760549798248448} = 4.038967834731578 \times 10^{-28}$
 $\frac{1}{4951760157141521099596496896} = 2.019483917365789 \times 10^{-28}$
 $\frac{1}{9903520314283042199192993792} = 1.0097419586828945 \times 10^{-28}$
 $\frac{1}{19807040628566084398385987584} = 5.048709793414472 \times 10^{-29}$
 $\frac{1}{39614081257132168796771975168} = 2.524354896707236 \times 10^{-29}$
 $\frac{1}{79228162514264337593543950336} = 1.262177448353618 \times 10^{-29}$
 $\frac{1}{158456325028528675187087900672} = 6.31088724176809 \times 10^{-30}$
 $\frac{1}{316912650057057350374175801344} = 3.155443620884045 \times 10^{-30}$
 $\frac{1}{633825300114114700748351602688} = 1.5777218104420225 \times 10^{-30}$
 $\frac{1}{1267650600228229401496703205376} = 7.888609052210112 \times 10^{-31}$
 $\frac{1}{2535301200456458802993406410752} = 3.944304526105056 \times 10^{-31}$
 $\frac{1}{5070602400912917605986812821504} = 1.972152263052528 \times 10^{-31}$
 $\frac{1}{10141204801825835211973625643008} = 9.86076131526264 \times 10^{-32}$
 $\frac{1}{20282409603651670423947251286016} = 4.93038065763132 \times 10^{-32}$
 $\frac{1}{40564819207303340847894502572032} = 2.46519032881566 \times 10^{-32}$
 $\frac{1}{81129638414606681695789005144064} = 1.23259516440783 \times 10^{-32}$
 $\frac{1}{162259276829213363391578010288128} = 6.16297582203915 \times 10^{-33}$
 $\frac{1}{324518553658426726783156020576256} = 3.081487911019575 \times 10^{-33}$
 $\frac{1}{649037107316853453566312041152512} = 1.5407439555097875 \times 10^{-33}$
 $\frac{1}{1298074214633706907132624082305024} = 7.703719777548937 \times 10^{-34}$
 $\frac{1}{2596148429267413814265248164610048} = 3.8518598887744685 \times 10^{-34}$
 $\frac{1}{5192296858534827628530496329220096} = 1.9259299443872342 \times 10^{-34}$
 $\frac{1}{10384593717069655257060992658440192} = 9.629649721936171 \times 10^{-35}$
 $\frac{1}{20769187434139310514121985316880384} = 4.8148248609680855 \times 10^{-35}$
 $\frac{1}{41538374868278621028243970633760768} = 2.4074124304840427 \times 10^{-35}$
 $\frac{1}{83076749736557242056487941267521536} = 1.2037062152420213 \times 10^{-35}$
 $\frac{1}{166153499473114484112975882535043072} = 6.0185310762101065 \times 10^{-36}$
 $\frac{1}{332306998946228968225951765070086144} = 3.0092655381050532 \times 10^{-36}$
 $\frac{1}{664613997892457936451903530140172288} = 1.5046327690525266 \times 10^{-36}$
 $\frac{1}{1329227995784915872903807060280344576} = 7.523163845262633 \times 10^{-37}$
 $\frac{1}{2658455991569831745807614120560689152} = 3.7615819226313165 \times 10^{-37}$
 $\frac{1}{5316911983139663491615228241121378304} = 1.8807909613156582 \times 10^{-37}$
 $\frac{1}{10633823966279326983230456482242756608} = 9.403954806578291 \times 10^{-38}$
 $\frac{1}{21267647932558653966460912964485513216} = 4.7019774032891455 \times 10^{-38}$
 $\frac{1}{42535295865117307932921825928971026432} = 2.3509887016445727 \times 10^{-38}$
 $\frac{1}{85070591730234615865843651857942052864} = 1.1754943508222863 \times 1$

DIAGRAM VII
Correlation of Groups A and B-Intelligence Quotient
with Oral Test 1-99 and Oral Test 2-100 $r = .37$
Intelligence Quotient

	80	85	90	95	100	105	110	115	F_x	I_x	$F I_x$	$F I_x^2$
	84	89	94	99	104	109	114	119				
100 96						1			1	4	4	16
95 91					1		1		2	3	6	18
90 86			1	3	4	2	4	2	16	2	32	64
85 81		1	2	2	3	5	1	2	16	1	16 (58)	16
80 76	1		1	9	5	8	1	1	26	0		
75 71			2	2	5	1	3		13	-1	13	13
70 66			2	4	3	3			12	-2	24	48
65 61	2		1	3					6	-3	18 (-55)	54
											3	229

F_y 3 1 9 23 21 20 10 5 92
 I_y -3 -2 -1 0 1 2 3 4
 $F I_y$ 9 2 9 (-20) 21 40 30 20 (111) = 91
 $F I_y^2$ 27 4 9 21 80 90 80 = 311

$$c_y = \frac{91}{92} = .988$$

$$s_y = \sqrt{\frac{311}{92} - .988^2 \times 5} = 1.55 \times 5 = 7.75$$

$$\bar{y} = .976$$

$$M_y = 102.44$$

$\Sigma x'y'$

8
12
56 2
24 4
2 16
4 18
21

127 -40
(87)

$$c_x = \frac{3}{92} = .033$$

$$c_x^2 = .001$$

$$C_x = .165$$

$$M_x = 78.67$$

$$\sigma_x = \sqrt{\frac{229}{92} - .001 \times 5}$$

$$= 1.57 \times 5$$

$$= 7.85$$

$$r = \frac{\frac{\Sigma x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{87}{92} - (.988 \times .033)}{1.55 \times 1.57}$$

$$= .37$$

$$P.E. = .06$$

Correlation of Protein A and B-Intelligence
with oral Test 1-30 and oral Test 2-30
Intelligence Quotient

	100	90	80	70	60	50	40	30	20	10	0
100											
90											
80											
70											
60											
50											
40											
30											
20											
10											
0											

100 100
 90 100
 80 100
 70 100
 60 100
 50 100
 40 100
 30 100
 20 100
 10 100
 0 100

100 100
 90 100
 80 100
 70 100
 60 100
 50 100
 40 100
 30 100
 20 100
 10 100
 0 100

DIAGRAM VIII

Correlation of Groups A and B-Intelligence Quotient
with Reading Test 1-99 and Reading Test 2-100

Intelligence Quotient

$r = .38$

	80	85	90	95	100	105	110	115	F_x	\bar{I}_x	$F\bar{I}_x$	$F\bar{I}_x^2$
	84	89	94	99	104	109	114	119				
100									2	4	8	32
96					2				2	4	8	32
95									10	3	30	90
91			2	1	2	2	1	2	10	3	30	90
90									16	2	32	64
86				3	2	7	4		16	2	32	64
85									14	1	14	14
81				2	2	5	3	2	14	1	14	14
80									22	0		
76		1	3	7	7	3		1	22	0		
75									14	-1	14	14
71	2			5	4	3			14	-1	14	14
70									12	-2	24	48
66	1		3	5	1		2		12	-2	24	48
65									2	-3	6	18
61			1		1				2	-3	6	18

F_y 3 1 9 23 21 20 10 5 92

\bar{I}_y -3 -2 -1 0 1 2 3 4

$F\bar{I}_y$ 9 2 9 (-20) 21 40 30 20 (111) = 91

$F\bar{I}_y^2$ 27 4 9 21 80 90 80 = 311

$$c_y = \frac{91}{92} = .988$$

$$\sigma_y = \sqrt{\frac{311}{92} - .976 \times 5}$$

$$c_y = .976$$

$$= 1.55 \times 5$$

$$C_y = 4.94$$

$$= 7.75$$

$$M_y = 102.44$$

$\Sigma x'y'$

8

51 6

56

29

6 10

12 14

3 3

165 -33
(132)

$$c_x = \frac{40}{92} = .434$$

$$c_x^2 = .188$$

$$C_x = 2.17$$

$$M_x = 80.67$$

$$\sigma_x = \sqrt{\frac{280}{92} - .188 \times 5}$$

$$= 1.69 \times 5$$

$$= 8.45$$

$$r = \frac{\frac{\Sigma x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

$$= \frac{\frac{132}{92} - (.988 \times .434)}{1.69 \times 1.55}$$

$$= .38$$

$$P.E. = .06$$

DIAGRAM IX

Correlation of Groups A and B--Reading Tests
1-99 and 2-100 with Oral Tests 1-99 and 2-100;
Reading Tests 1-99 and 2-100 r=.62

Reading Tests 1-99 and 2-100

	61 65	66 70	71 75	76 80	81 85	86 90	91 95	96 100	F_x	\overline{J}_x	FJ_x	FJ_x^2	$\sum x'y'$
100 96					1				1	4	4	16	4
95 91						1		1	2	3	6	18	18
90 86	1			1	3	6	5		16	2	32	64	60 6
85 81				4	1	6	5		16	1	16 (58)	16	28
80 76		3	6	8	6	2		1	26	0			
75 71	1	4		5	3				13	-1	13	13	11 3
70 66		2	6	3		1			12	-2	24	48	20 4
65 61		3	2	1					6	-3	18 (-55)	54	24

Oral Tests 1-99 and 2-100

	61 65	66 70	71 75	76 80	81 85	86 90	91 95	96 100	F_x	\overline{J}_x	FJ_x	FJ_x^2	$\sum x'y'$
100 96					1				1	4	4	16	4
95 91						1		1	2	3	6	18	18
90 86	1			1	3	6	5		16	2	32	64	60 6
85 81				4	1	6	5		16	1	16 (58)	16	28
80 76		3	6	8	6	2		1	26	0			
75 71	1	4		5	3				13	-1	13	13	11 3
70 66		2	6	3		1			12	-2	24	48	20 4
65 61		3	2	1					6	-3	18 (-55)	54	24

$$C_{\lambda} = \frac{3}{92} = .033$$

$$C^2_X = 00/$$

$$C_x = .163$$

$$M_x = 78.67$$

$$\sigma_x = \sqrt{\frac{279}{92} - .001} \times 5$$

$$r = \frac{\sum x'y'}{N} - c_x c_y$$

$$= \frac{\frac{152}{92} - (.445 \times .033)}{1.68 \times 1.57}$$

P.E. = .04

TABLE IX
 Correlation of Groups A and B--Reading Tests
 1-35 and 3-100 with Oral Tests 1-25 and 2-100
 Reading Tests 1-35 and 2-100

A	B	C									
		1	2	3	4	5	6	7	8	9	10
1	1										
2	2										
3	3										
4	4										
5	5										
6	6										
7	7										
8	8										
9	9										
10	10										
11	11										
12	12										
13	13										
14	14										
15	15										
16	16										
17	17										
18	18										
19	19										
20	20										
21	21										
22	22										
23	23										
24	24										
25	25										
26	26										
27	27										
28	28										
29	29										
30	30										
31	31										
32	32										
33	33										
34	34										
35	35										

$\frac{1}{2} = .50$
 $\frac{1}{3} = .33$
 $\frac{1}{4} = .25$
 $\frac{1}{5} = .20$
 $\frac{1}{6} = .17$
 $\frac{1}{7} = .14$
 $\frac{1}{8} = .13$
 $\frac{1}{9} = .11$
 $\frac{1}{10} = .10$
 $\frac{1}{11} = .09$
 $\frac{1}{12} = .08$
 $\frac{1}{13} = .08$
 $\frac{1}{14} = .07$
 $\frac{1}{15} = .07$
 $\frac{1}{16} = .06$
 $\frac{1}{17} = .06$
 $\frac{1}{18} = .06$
 $\frac{1}{19} = .05$
 $\frac{1}{20} = .05$
 $\frac{1}{21} = .05$
 $\frac{1}{22} = .05$
 $\frac{1}{23} = .04$
 $\frac{1}{24} = .04$
 $\frac{1}{25} = .04$
 $\frac{1}{26} = .04$
 $\frac{1}{27} = .04$
 $\frac{1}{28} = .04$
 $\frac{1}{29} = .03$
 $\frac{1}{30} = .03$
 $\frac{1}{31} = .03$
 $\frac{1}{32} = .03$
 $\frac{1}{33} = .03$
 $\frac{1}{34} = .03$
 $\frac{1}{35} = .03$

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